Proceedings of the European Union's Contention in the Reshaping Global Economy

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The *European Union's contention in the reshaping global economy – The 4th Conference in cooperation with the European Association for Comparative Economic Studies* was organized by the University of Szeged Faculty of Economics and Business Administration. Participants were invited to submit their research papers. This proceedings contains a selection of these reviewed papers.

Proceedings of the European Union's Contention in the Reshaping Global Economy

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Preface

The European Union's contention in the reshaping global economy – *The 4th Conference in cooperation with the European Association for Comparative Economic Studies was* organized by the University of Szeged Faculty of Economics and Business Administration on 20–21 May 2021, online.

The global economy has been going through severe changes in several dimensions recently. The long-term impacts of the coronavirus pandemic and the ongoing technological innovations, the 4th industrial revolution may rearrange trade relationships and global value chains both inside and outside the European Union and may modify the role of the state as well. Signs of this process are already present in the Central and Eastern European countries. The perspectives of a US-China trade war alter day by day. Due to growing awareness of climate change, the pressure on the industry has increased - especially on the automotive sector - to reduce environmental damages unexpectedly fast. The new situation requires new answers in the various fields of policies. The European integration has to respond to challenges after Brexit and before the long-delayed Western Balkan enlargement.

Conference participants were invited to submit their research papers that address the reshaping global economic landscape from the viewpoint of European integration and economies. This proceeding contains these reviewed papers. Papers based on the approach of either economics, political economy, or business studies were welcome.

The studies in the first chapter examine the economic development and economic responses following Covid 19 including impact on the European banking sector, on digitalization, on trade relations, on environmental policy, on poverty, and on macroeconomic policy. The second chapter focuses on the changing business environment and new business models emerging today e.g. highlighting the attitudes of institutions, companies, and markets towards climate change, challenges of Industry 4.0 in a Hungarian context, and new strategic directions for companies.

We would like to thank the authors, reviewers for their work. Special thanks to Bettina Ambrus for formatting the document with high precision.

Szeged, 2022

The editor and the organizers of the conference

Chapter I
Economic development and economic policy responses

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Covid-19 impact on the profitability of the EU27 banking sector

Péter Juhász – Tahir Mammadov

Due to COVID-19, economic activity decreased considerably all across Europe. Our paper reviews the various pandemic effects and changes in the European banking sector. Using a dataset merged from four different secondary databases, we created a panel of country-quarters with 513 items covering the period 2016 Q1 – 2020 Q3 including the effects of the first wave of the pandemic. Correlation analysis revealed that during the pandemic, the connectedness of the banking system to the macroeconomy increased, and that the open economies had a more stable banking system. Performance fluctuations on the national banking system level increased, and banking performance became more closely linked to quarterly GPD growth. Covid-19 had a significant adverse effect on the banking sector's profitability on top of the standard macroeconomic fallbacks. Data also underpin that the countries where citizens had stronger trust in their government (political system, legal system, police) suffered less due to the Covid-19 crisis than other EU27 members. High-trust EU27 countries lost less in GDP, import, export, and banking profitability during the first wave of the pandemic. However, this might be partly also a result of some cultural characteristics linked to geography.

Keywords: pandemic, economic effect, ROE, financial sector, trust
JEL CLASSIFICATION INDICES
F44, G01, G21, H12

1. Introduction

The Covid-19 pandemic outbreak in early 2020 hit national economies heavily all over the world. Initially, it seemed that the banking sector in more developed countries would suffer less due to their preparedness for online transactions and electronic payments, and because most banking jobs can be performed very well from home. Later in the year, however, financial institutions also started to feel the adverse effects. Surprisingly, we find massive variance in banking profitability even among the EU27 countries.

Our paper investigates what factors might have contributed to those differences and whether the Covid-19 pandemic might have any unique effects on banking profitability on top of weakening national economies. We also assumed that direct Covid-19 effects like the number of diagnosed cases and excess mortality could have an immediate significant impact on the banks return on equity (ROE) ratios. As citizens' trust in their government may contribute to the upholding of lockdown rules and thus minimise pandemic effects, we also tested whether countries with higher trust levels had seen less of the drawbacks of the crisis

2. Literature review

Due to the very different structure of national economies, their level of dependence on foreign financing and the various government reactions to the pandemic, firms worldwide have seen very diverse changes and tendencies in their performance. In the case of China, small and medium-sized companies and firms operating in the most affected industries like tourism, notably airlines, showed a significant decrease in their financial performance. At the same time, the number of new loans and credits issued to these types of firms decreased considerably (Rababah et al., 2020). Stock market volatility, economic policy uncertainty, a significant decrease in the primary commodity prices, such as crude oil, were noted in particular in the US (Jeris–Nath 2021). In their wavelet approach study, the authors found the return of bank indices heavily driven by Covid-19 cases, and it was more sensitive to US Covid-19 cases than the rise of global Covid-19 cases.

Banks tightened their credit policy and faced increased write-offs. However, the COVID-19 effect varied across institutions. It seems that the extent Covid-19 hit certain banks would be connected to their earlier financial status. Korzeb and Niedziółka (2020) analysed the 13 largest Polish banks and concluded that end of 2019 return of equity (ROE), non-performing loans, and 2017–2019 write-offs were strongly connected to the cost of risk (CoR) in the first quarter of 2020. Based on their analysis, large and medium-sized banks with sound economic and financial vitals and low funding costs followed a conservative credit and provisions policy. So, write-offs concerning specific exposures are not likely to emerge. On the other hand, though, small banks with poor profitability, low levels of regulatory capital, and a high cost of funding were more severely hit by the pandemic.

In similar research conducted by Hardiyanti and Aziz (2021), a significant positive impact of the Covid-19 pandemic on the number of non-performing loans has been noticed for conventional banks in Indonesia. The level of non-performing loans in the national banking industry increased from 2.53% in December 2019 to 2.7% in February 2020. Many small and medium-sized banks ended up in bankruptcy due to bad credit in Indonesia.

Ari et al. (2020) defines dealing with NPLs and designing effective NPL resolution policies for the post-Covid-19 period as crucial for achieving economic recovery in the EU. In comparison with the great financial crisis, the authors found that European banks entered the Covid-19 crisis with higher capital ratios but less profitability and higher public debt, making NPL resolution more challenging.

The European Banking Authority evaluated the situation of banks during the pandemic as being better than during the global financial crisis in 2008-2009 (EBA 2020). According to their results, the liquidity coverage ratio and the common equity tier 1 ratio were well above the regulatory requirements. However, profitability and operating expenses were noted as the main concerns of the banks. The increasing trend in the number of non-performing loans was also projected to continue for the near future. The paper also identified a considerable level of deterioration in the funding conditions of banks. They underlined that about 20 per cent of securities issued by banks would mature in the next six months, and an additional 10 per cent would mature just within one year (EBA 2020).

In response to the Covid-19 pandemic, different types of containment and mitigating measures have been introduced by many governments around the globe. However, central banks have the highest exposure to the risk and need to take prompt actions during the crisis period. Although during the Great Financial Crisis, the ECB showed extremely cautious gradualism, in response to the Covid-19 crisis,the ECB demonstrated immediate intervention to decrease uncertainty and provide stability (Morelli–Seghezza 2021).

In their research, Guth et al. (2020) find the effectiveness of these measures in the Austrian economy during the first wave of the pandemic. The authors suggested that while the mitigating measures only partly offset the economic shock caused by Covid-19, they played an essential role in lowering insolvency rates both on an aggregate and in the hardest-hit sectors. Furthermore, an indirect impact of the mitigating measures has explicitly been noticed in the banking sector capitalisation in Austria. The research findings revealed that the Austrian banking system remained well-capitalised despite the expected increase in insolvencies.

The positive results of central bank action to stabilise financial conditions, providing access to credit and liquidity, were also underlined by Mosser (2020). However, this research also suggested that central bank policy can only impact the situation indirectly, and there is still a considerable risk to the economy and financial system. The prompt response from central banks can only address the crisis challenges for the short term. For deleveraging the economy and increasing economic activity, the inclusion and confidence of other fiscal authorities are essential for long-run economic stability.

In their study, Rizwan et al. (2020) find an initial sharp increase in systemic risk in most Covid-19 affected countries. However, by the end of April 2020, the situation changed positively, which could be the result of policy responses. Wullweber (2020) believes the COVID-19 crisis has proved that financial markets in their current form cannot serve as a firewall against economic downturns. Due to the crisis remedies, the demand and supply of credit become once again determined by central banks that are not very successful in stabilising the financial markets. He underlines the rush for safety when the crisis started, which was later followed by a run for liquidity. This process caused a downward price and liquidity spiral, resulting in widespread insolvency.

The importance of robust risk management practices and well-established risk management cultures within financial institutions was analysed once again during the Covid-19 pandemic. Falzon-Vella (2020) proved the positive relationship between a higher level of risk management and better bank performance through return on assets (ROA) and annual returns during the prolonged crisis period of 2008–2011. However, the study results also underlined that, unlike in a single-wave crisis period, more robust risk management practices do not benefit from superior bank performance and market rewards during a multiple-wave crisis period (Falzon-Vella 2020).

Schildbach (2020) underlines that European banks suffered more due to the first wave of COVID-19 than their US counterparts. The 20 major EU banks saw their revenues drop by 5% (US: 2%) in a year on year comparison during the first half of 2020. It was loan loss provisions that more than tripled that had the most significant effect on profitability.

Deloitte (2020) carried out research in August 2020 in the CEE banking sector. They asked 69 banks' chief risk officers and heads of work departments across twelve countries to find that new loan disbursement was expected to fall and credit standards to tighten over the year. Managers also predicted that costs associated with restructuring and workouts would rise.

After the end of the third quarter, KPMG (2020) found that expected credit losses (ECL) caused the profitability of the EU banks to fall. In their sample, the average change of ECL compared to the comparative quarter in 2019 were 600% in Q1, 400% in Q2, and 40% in Q3. In addition, payment holidays and other COVID-19 borrower relief programmes also produced fallouts in incomes.

When judging the European banks' total 2020 performance, the IMF (Aiyar et al., 2021) found that financial institutions remain broadly resilient to the shock despite the significant fall in capital ratios. They highlight that good policies are needed to substantially weaken the link between the macroeconomic shock and the banks' capital. They also propose that the regulators address structurally low bank profitability. As impairments and provisions materially lower the return on assets, banks have a limited ability to restore capital buffers. As the recent investment in digital technologies is likely to increase expenses over the short term, banks have to improve their cost structure radically and look for non-interest incomes. Further domestic and cross-border consolidation of the sector could improve efficiency and aid in a better allocation of holding capital and liquidity.

Regardless of good or bad times in financial markets, the investor profile defines investment strategies. Ilie (2020) finds the financial market volatility to be very high during the Covid-19 pandemic. The study projected that due to the market's high volatility, the investors with less risk appetite would follow less risky stocks, even if the earning opportunities are very high. In the study of 13 Canadian financial institutions, Tullo (2020) defines the Covid-19 as the most significant non-financial risk (NFR) crisis of our times. The paper suggests that integrating NFR management into their business strategies and enterprise resource management system will be the best practice for Canadian financial institutions.

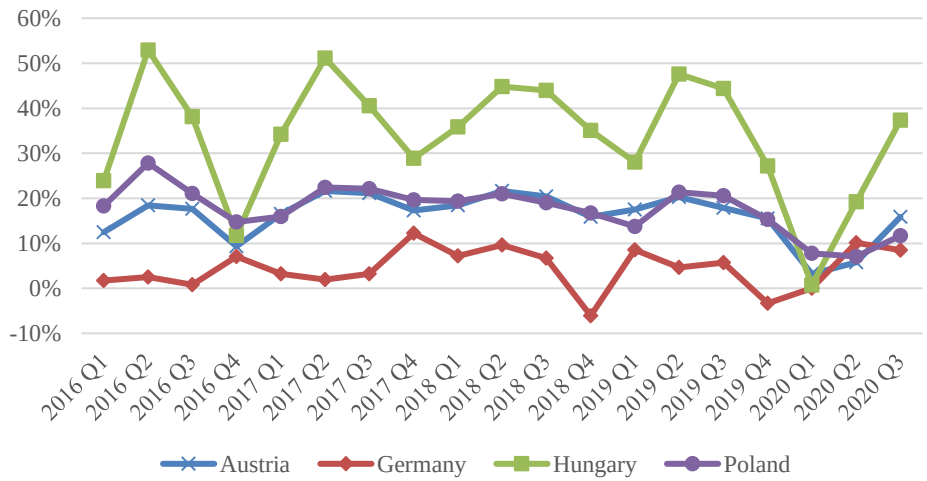
The Covid-19 pandemic created uncertainties in the economy, politics, and financial markets, and challenged the traditional way of making financial transactions. One of the most Covid-19 affected aspects of the banking industry was the nature of financial transactions. Despite the disruption in economic activities, Weimert and Saiag (2020) find a sharp increase in the volume of online transactions. Their findings also revealed a 50 per cent decrease in the overall spending in Western European countries. In addition, Google and Apple have reported significant increases in the overall number of payments and users of their X-pay digital solution (Weimert and Saiag 2020). However, the pandemic also invited several new competitors to the market. As a result, the quality and availability of such services increased significantly compared to the pre-pandemic period.

To sum up, it seems to be clear that, due to the Covid-19 pandemic, banks faced not only classic problems linked to the general economic downturn that decreased asset quality but also saw several new direct banking effects emerging, raising their costs and risks. In that respect, the current pandemic-caused crisis is more complex for the financial system than the earlier economic downturns were.

3. Data and methodology

Our study focuses on the national banking performance of the EU27 countries during the period 2016 Q1-2020 Q3. To set up our database, we collected secondary data from several data providers. The national level banking system quarterly ROE (Return on Equity) data for the EU27 countries originates from the European Central Bank (ECB, 2021) official website. (Figure 1) We used the Organisation for Economic Co-operation and Development database (OECD, 2021) to collect data on quarterly changes of import, export, and GDP growth datasets for different countries. Covid-19 cases and excess mortality data during 2020 Q1 – 2020 Q4 have been collected from the Our World in Data (2021) database. We gained data regarding trust in government, the police, and the legal system in 2019 from Eurostat (2021) official databases.

Figure 1 Quarterly ROE of the banking system in selected countries



Source: ECB (2021)

Using the data collected, we also set up a panel database that contained 513 country-quarters. Next, we included the national banking level quarterly ROE and quarterly growth of GDP, import, and export for each item.

Many factors determine the ROE ratio level of a single bank or the average ROE of the whole banking system of a given country. Those country-specific issues may include inflation, the general risk level of the banking sector, or the real risk-free rate. (Note that only 19 of the EU27 countries are members of the eurozone.) Thus, simply focusing on country groups with low or high ROE during 2020 would mix up pandemic effects and country-specific effects.

Also, when analysing the quarterly ROE ratios, we detected both seasonality and autocorrelation. While first differentiating of the quarterly ROE ratios could solve autocorrelation, seasonality might have stayed. Thus, to eliminate both of these potential distortions, we calculated for each country and quarter the yearly change of the quarterly ROE ratios (ROEt-ROEt-4). (Table 1)

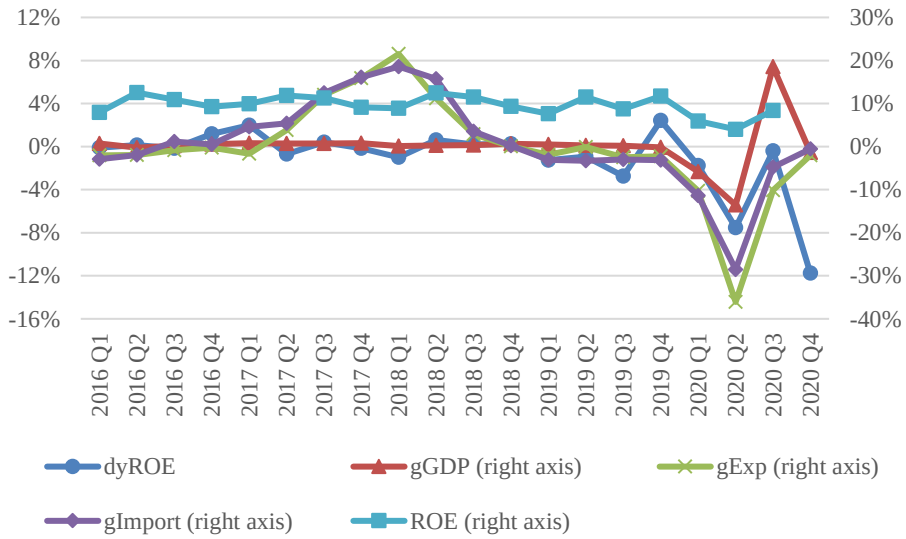
Table 1 Autocorrelation of quarterly ROE for banks in EU27 countries (2016 Q1–2020 Q3)

	t-1	t-2	t-3	t-4
ROE_t	.434**	.512**	.281**	.577**
$dyROE_t=ROE_t-ROE_{t-4}$	–.182**	–.013	.052	

**p<0.05 **p<0.01*

Source: own results

Figure 2 Yearly change in quarterly ROE, and quarterly growth of GDP, import, and export in France



Source: Based on ECB (2021) and OECD (2021)

Results show that the autocorrelation was radically reduced, and the connections became, in most cases, insignificant. This change is why we focus on yearly changes in quarterly ROE ratios during the rest of the paper. The paper references this variable as dyROE. (Figure 2).

3.1. Covariance analysis

As a first step in identifying crisis effects, we calculated the correlation matrix for our variables. The statistics revealed several significant connections shown in Tables 2–5. However, as earlier research suggests that correlations tend to change during crisis periods, coefficients were calculated not only for the whole period but also separately for the before-pandemic and the pandemic quarters as well.

Table 2 Correlation with $dyROE_t$ during the whole period examined (2016 Q1–2020 Q3)

	t	**t-1**	**t-2**	**t-3**	**t-4**
ROE	.257**	.072	–.126**	–.115**	–.633**
gGDP	.175**	–.027	.168**	.075	.010
gExport	.179**	.083	.066	–.008	–.071
gImport	.216**	.138**	.096	.008	–.060
dyROE		–.101*	.013	.052	

**p<0.05 **p<0.01*

Source: own results

Table 3 Correlation with $dyROE_t$ during the non-pandemic periods (2016 Q1–2019 Q4)

	t	**t-1**	**t-2**	**t-3**	**t-4**
ROE	.180**	.054	–.162**	–.107*	–.668**
gGDP	–.027	–.033	–.015	–.041	.000
gExport	.067	.021	–.090	–.100	–.143*
gImport	.058	.044	–.082	–.105	–.145**
dyROE		–.247**	.024	.476**	

**p<0.05 **p<0.01*

Source: own results

When contrasting the correlations measured during different periods, we may conclude that a new significant negative correlation with GDP growth, import, and export during the previous quarter emerged. However, the negative sign is counterintuitive as it suggests that countries more hit by cutbacks on their foreign trade saw their banking profitability growing. This could be because more open economies suffered more due to a fall in foreign trade and had a more stable banking system, but there is no causality between the two phenomena.

At the same time, the current quarter growth of GDP became positively correlated. Besides that, the positive connection to the current quarter ROE ratio was boosted. We may interpret this change as the quarterly performance of banks being more dependent on the current quarter changes. In other words, the performance saw a higher fluctuation than earlier. Thus, the pandemic affected economic processes, connecting the banks' performance more directly to the macroeconomy of the given country.

Table 4 Correlation with $dyROE_t$ during the pandemic periods (2020 Q1–2020 Q3)

	t	**t-1**	**t-2**	**t-3**	**t-4**
ROE	.613**	–.154	–.196*	–.241*	–.479**
gGDP	.364**	–.203*	–.020	.016	–.154
gExport	.055	–.440**	–.047	–.029	–.017
gImport	.168	–.382**	.028	.027	–.090
dyROE		–.279**	–.171	.046	

**p<0.05 **p<0.01*

Source: own results

Table 5 Correlation with $dyROE_t$

(Same quarter)	Total sample 2016 Q1–2020 Q3	Pandemic only 2020 Q1–2020 Q3
Covid Cases per million	–.193**	–.164
Accumulated Covid Cases per million	–.193**	–.139
Excess Mortality	–.259**	–.077

**p<0.05 **p<0.01*

Source: own results

As for our variables directly linked to Covid-19 (Table 5), it seems that there is no direct linear connection between the performance changes and how heavily the pandemic hit the given country. However, where those variables are not equal to zero, the whole pandemic period is different to the earlier quarters. This difference results in the connection being significantly over the entire sample level.

3.2. Panel regressions

To measure the effects of the variables simultaneously, we estimated panel regressions that also included dummies for all year and quarter effects. Based on the results of the correlation analysis, we expect the dummy of 2020 to be significant even when controlling for the macro factors.

As the last analysis showed a significant connection to dyROEt-1 (the yearly change of ROE a quarter earlier), we included that variable. Because of this, we had to drop 2016 from the analysis due to a lack of data. As a robustness check, we re-estimated the model without including dyROEt-1. We calculated this later model removing the quarter dummies as those did not prove significant. To be able to contrast year dummy coefficients, 2017 was selected as the base year (Table 6).

Table 6 Panel regression results

	Model 1		Model 2		Model 3	
	Beta	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig**
Constant (2017)	.029	.121	.030*	.041	.019	.414
2016dummy					.013	.589
2018dummy	–.030	.064	–.030	.062	–.029	.178
2019dummy	–.043*	.037	–.043*	.034	–.036	.189
2020dummy	–.120**	.000	–.121**	.000	–.110**	.000
Q2dummy	.005	.773			.013	.514
Q3dummy	–.004	.834			–.004	.824
Q4dummy	.003	.846			.006	.762
gGDP	.006**	.001	.006**	.000	.006**	.009
gExp	–.002	.211	–.002	.215	–.002	.393
gImport	.002	.221	.002	.222	.002	.344
Q-1dyROE	–.136**	.001	–.134**	.001		
R Square	.255		.254		.139	

**p<0.05 **p<0.01*

Source: own results

When comparing the three models, we do not see significant differences across coefficient values and significance levels; thus, the results are robust. In all our models, the dummy of 2020 was significant, causing an 11.0–12.1 percentage fallback in quarterly ROE values. At the same time, higher GDP growth in the current quarter implied significantly higher ROE ratios. In two of our models, 2019 had a significant negative effect on ROE, indicating that 2020 is very likely to be the second poor year in a row for banking in the EU27 countries.

We may conclude that the pandemic harmed the banks' profitability on top of the usual effects of macroeconomic fallbacks. This result hints to Covid-19 having a non-standard way of affecting banking operations. This conclusion is well underpinned by the literature quoting extra expenses linked to home office infrastructure, additional disinfection expenses, and boosting of online banking and electronic payment capabilities.

3.3. Clustering on Trust

We collected data from Eurostat on trust in police and the political and legal system across the EU27 countries. We assumed that citizens having a more solid confidence in the officials' imposing certain kinds of precautionary rules (e.g., lockdown, Obligation of wearing masks) would be more disciplined in following the rules as thus Covid-19 may have a lesser effect on the country.

To test our hypothesis, we calculated both correlations among trust variables and effect-measures and created two clusters of the countries based on their general level of trust in those three dimensions. Table 7 summarises the significant correlations identified, while Figure 3 illustrates the spatial distribution of the two clusters.

Our results show a significant and negative connection between trust variables and the excess mortality across three of the four quarters of 2020, justifying our initial assumption. However, it is only during Q2 of 2020 that we measured a positive connection with the yearly difference of the quarterly ROE of the given banking system. Interestingly, during Q2, we could not confirm the relationship between trust variables and excess mortality. So, it seems that during Q2, banks suffered less in countries where citizens had more solid trust in their government.

Table 7 Correlations with trust variables

Year 2020	**Trust in the political system**	**Trust in the police**	**Trust in the legal system**
dyROEQ1	–.043	.010	–.072
dyROEQ2	.646**	.450*	.476*
dyROEQ3	.091	.284	.295
Trust Political		.696**	.886**
Trust Police	.696**		.868**
Trust Legal	.886**	.868**	
Excess Mortality Q1	–.433*	–.478*	–.600**
Excess Mortality Q2	–.232	–.136	–.376
Excess Mortality Q3	–.393*	–.436*	–.513**
Excess Mortality Q4	–.461*	–.538**	–.581**

**p<0.05 **p<0.01*

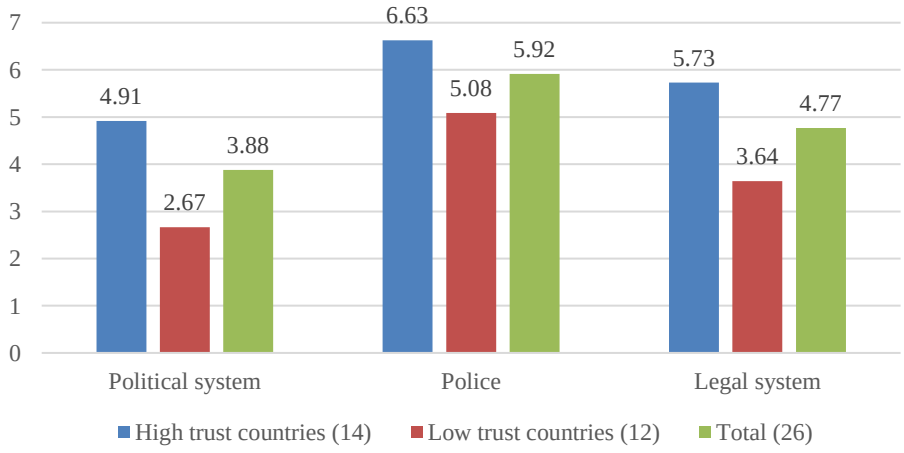
Source: own results

We created two clusters based on the standardised values of three trust measures (Figures 3 and 4). While we could not find any significant differences in excess mortality between the two groups, the Q2 ROE, quarterly export and import growth, Q1, Q2, and total yearly GDP growth, and dyROE ratios deviated significantly (Table 8).

Figure 3 The spatial distribution of the trust clusters

Source: own results

Figure 4 Differences in types of trust between clusters*



**High trust countries:* Austria, Belgium, Denmark, Estonia, Finland, Germany, Hungary, Ireland, Lithuania, Luxembourg, Malta, Netherlands, Romania, Sweden. *Low trust countries:* Bulgaria, Cyprus, Czech Republic, France, Greece, Italy, Latvia, Poland, Portugal, Slovakia, Slovenia, Spain. Croatia not categorised due to lack of data.

Source: Based on Eurostat (2021)

Table 8 Trust clusters profitability values

Year 2020	**High trust**	**Low trust**	**Total**
dyROEQ1	–0.0935	–0.0909	–0.0923
dyROEQ2	–0.1160*	–0.2246*	–0.1661
dyROEQ3	–0.0350	–0.0417	–0.0381
gGDPQ1-2020	–1.4602*	–3.2045*	–2.2597
gGDPQ2-2020	–8.2015*	–11.2362*	–9.5924
gGDP2020	–3.1109**	–6.4035**	–4.6200
gExpQ2-2020	–18.7696*	–26.8145*	–22.3898
gImportQ2-2020	–19.7167**	–28.1084**	–23.4929

** p<0.05 ** p<0.01*

Source: own results

Thus, we may conclude that economies with a higher level of trust in their governments suffered less during the first wave of the pandemic, most likely due to upholding regulations more consistently. As a result, these countries lost less in GDP, export, import and banking profitability.

However, when analysing Figure 3, we may also conclude that there might be some spatial effects behind these results. Mediterranean countries suffered considerably due to the fallback of tourism that is typically a critical economic driver in the area. So, a bigger fallback in financial performance may be linked to the higher role of the badly hit tourism sector, and it is just by random that those countries share the characteristic of having lower citizen trust. Nevertheless, this would not offer a reasonable explanation why Poland, Czechia, Slovakia, and Latvia belong to the same group where tourism is less critical.

4. Conclusion

This paper analysed how the Covid-19 pandemic affected the banking system performance across the EU27 countries from 2016 Q1 to 2020 Q3. This period covers the first wave of the crisis.

Correlation analysis revealed that during the pandemic, the connectedness of the banking system to the macroeconomy increased but surprisingly, the link to the change in exports and imports was negative. The open economies suffered more due to falls in foreign trade but still had a banking system with more stable profitability. We also found that performance fluctuations on the whole banking system level increased and that banking performance was more closely linked to the quarterly GPD growth.

Our panel regression discovered that Covid-19 had a significant adverse effect on the banking sector's profitability on top of the standard macroeconomic fallbacks. Results confirmed the positive impact of quarterly GDP growth on ROE of the banks for 2017–2020 in the EU27 countries.

Data also hint that the countries where citizens had stronger trust in their government (political system, legal system, police) suffered less due to the Covid-19 crisis than other EU27 members. Not only banking performance was better there than in different countries, but excess mortality was also lower. Our cluster analysis highlighted that high-trust EU27 countries lost less in GDP, import, export, and banking profitability during the first wave of the pandemic. However, this phenomenon might be partly caused by some common cultural traits of the countries with similar geographic locations.

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Impact of COVID-19 on real effective exchange rates of EU member countries: Implications for a monetary union

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There is a lack of close historic parallel to the economic impact of COVID-19. The COVID-19 shock has led to most economies in the Euro area experiencing exchange rate pressures, enormous job losses and contractions in output. By recognising that a stable currency has the tendency to reverse some of these challenges, this study investigates the impact of the pandemic on the exchange rate of all EU member countries. The main objective is to find the relationship between the government's lockdown measures measured by the Stringency index and monthly exchange rate per the USD for all EU member countries. Using both a correlation and a Dynamic Ordinary Least Square (DOLS) model, the results show that as lockdown measures intensified, countries in Europe lost their competitiveness in the long-run. In the short-run however, only Cyprus, the Czech Republic and Greece lost their competitiveness as the lockdown measures intensified. The results also confirm the asymmetry of shocks in Europe, further questioning the benefits for countries seeking to adopt the Euro.

Keywords: European Union, exchange rate, monetary union, COVID-19.

1. Introduction

The widely held view that the rise of the euro as a regional anchor currency may well herald an enlargement of the European Monetary Union (EMU) appears to have been challenged by the COVID-19 pandemic. Currently, the euro (€) is the official currency of 19 out of 27 European Union (EU) member states, which together constitute the Eurozone, officially called the euro area. According to Dabrowski (2019), the first two decades of euro functioning have confirmed its stability, as it is currently the second most important global currency. Even though the traditional currency literature suggests structural criteria such as factor mobility, trade integration and regional production patterns to assess a country's readiness to join a monetary union, recent literature, however, points to the importance of flexible nominal exchange rates in this regard. The potential benefits of a single European currency include the elimination of transaction costs for firms and travellers, and the reduction of exchange rate uncertainty (Funke 1997).

The COVID-19 pandemic is showing no sign of slowing down as countries develop effective ways of reducing infection rates. As of May 9, 2021, the European Region – as defined by the World Health Organization (WHO) – reported over 897,000 new cases and just under 19,000 new deaths, a 25% and 18% decrease, respectively, compared to the week ending May 4, 2021 (WHO 2021). The highest numbers of new cases were reported from Turkey, France and Germany. According to Feng et al. (2021) and Aslam et al. (2020), the COVID-19 pandemic is an economic shock with arguably no historical comparison. Despite this there are limited studies on the impact of the

pandemic on the exchange rate of countries in Europe. Since most of these countries trade with each other, the nominal exchange rate may not be a good measure of competitiveness among the investigated countries. This is what necessitates the use of the REER, which is also a measure of international competitiveness of a nation in comparison with its trade partners. The REER gives an important information to market participants regarding the mix of foreign versus domestic goods on both the production and the purchasing side. An increasing REER will generally mean that a country is losing its competitive edge.

Using both a correlation and a Dynamic Ordinary Least Square (DOLS) model, this study investigates the impact of the pandemic on the exchange rate of countries in Europe. The results show that as lockdown measures intensified, countries in Europe lost their competitiveness in the long-run. In the short-run however, only Cyprus, the Czech Republic and Greece lost their competitiveness as the lockdown measures intensified (the Czech Republic still uses its own currency, while Cyprus and Greece have been subjects of an European Stability Mechanism (ESM) program). The results also confirm the asymmetry of shocks in Europe, further questioning the benefits for countries seeking to adopt the Euro.

The rest of the paper discusses the body of literature on the subject, the data and method used to analyse the impact of the pandemic on the exchange rate of countries in Europe, and, finally, a conclusion and recommendation section.

2. Theoretical background and literature review

Prior to the introduction of the Euro in 2002, there were questions about whether Europe is ready for a common currency. Studies at the time focused on the pros and cons of joining a currency union. The main economic cost as espoused by these studies results from the loss of nominal exchange rate flexibility as an instrument for real exchange rate (RER) adjustment between regions exposed to asymmetric shocks (Von Hagen–Neumann 1994, Funke 1997).

Even though the traditional currency literature suggests structural criteria such as factor mobility, trade integration and regional production patterns to assess a country's readiness to join a monetary union, recent literature, however, points to the importance of flexible nominal exchange rates in this regard. This is because a flexible exchange rate serves as a shock absorbing mechanism in the case of strong asymmetric shocks (Von Hagen–Neumann 1994, Beirne–Bijsterbosch 2011, De Grauwe–Schnabl 2008, Belke–Gros 2001). Devereux et al. (2003), on the other hand, argue that the acceptance of the euro will lead to European prices becoming more insulated from exchange rate volatility. This effect, according to Devereux et al. (2003), can also be found in the US. The assumption of a sticky price intertemporal model by Devereux et al. (2003) makes their conclusion similar to that of Von Hagen and Neumann (1994). Thus, the loss involved in not making use of the nominal exchange rate as an instrument of macroeconomic adjustment is smaller when shocks require little movement of the real exchange rate to establish an equilibrium. The potential benefits of a single European currency include the elimination of transaction costs for firms and travellers and the reduction of exchange rate uncertainty (Funke 1997).

A lot of studies have, thus, concluded that shocks have different effects on countries in Europe. Investigating the nature of shocks in Europe and in Germany, Funke (1997) found that demand and supply shocks in the various countries in Europe are not highly correlated (Bjørnland 2004). Habib (2002) identified the Czech Republic as an example of a country where the exchange rate could not act as an external shock absorber and insulate the country's domestic monetary policy completely from such shocks. This view, though, is contrary to findings by Edwards and Yeyati (2005), who found that terms of trade shocks get amplified in countries that have more rigid exchange rate regimes. Like Funke (1997), Sekkat and Mansour (2005) also found that exchange rate fluctuations do indeed have different impacts across sectors in Europe. These differences, according to Sekkat and Mansour (2005), are non-negligible due to dissimilarities among member states' industrial structures. Bjørnland (2004), on the other hand, proposes that relinquishing exchange rate independence should come at little cost, making exchange rate independence attractive.

The evidence of asymmetry in Europe has the tendency of making the exchange rate pass-through (ERPT), a measure of how responsive prices are to the exchange rate, in Europe not to be constant over time, as discovered by Comunale and Kunovac (2017). According to Comunale and Kunovac (2017), the level of ERPT is dependent on the composition of economic shocks governing the exchange rate in European countries. Comunale and Kunovac (2017) also contend that the ERPT is strongest when the shocks originate from monetary policy or the exchange rate. Bénétrix and Lane (2018) make the same case but for fiscal shocks in Europe. They found that the impact of fiscal shocks differs across different types of government spending in Europe, with shocks to public investment generating larger and more persistent real appreciation than shocks to government consumption.

Theoretically, there is a significant relationship between fiscal shocks and the real exchange rate. Fiscal expansions may induce real appreciations, which may contribute to problems with competitiveness that may be hard to reverse inside a monetary union. Therefore, in designing an optimal fiscal policy, the relationship between various types of government spending and the real exchange rate cannot be ignored (Bénétrix and Lane, 2018).

The COVID-19 pandemic qualifies as a trade shock. It also qualifies as a fiscal and monetary policy shock. According to Feng et al. (2021), the COVID-19 pandemic has affected the world economy and various sectors of the economy. Many countries around the world have been forced to impose, among other measures, travel restrictions, border shutdowns, lockdowns, and social distancing in order to control the pandemic (Aslam et al. 2020). A sudden shock like this – as experienced during the 2008 financial crisis – has the tendency to cause structural changes in both commodity and financial markets, which can then have potential asymmetric effects on market efficiency, portfolio allocation, and volatility spill overs. The impact of the pandemic on the exchange rate market cannot be understated either, as most central banks scrambled to adjust their monetary policy frameworks to address the feedback loop between exchange rate movements and capital outflows in a bid to weather the financial setbacks from the COVID-19 pandemic. The concern is driven by the decrease in aggregate and foreign demand, which has the tendency to put pressure on the currencies the world over (Aslam et al. 2020).

Investigating the exchange rate volatility response to COVID-19 pandemic and government interventions over the period January 13, 2020 to July 21, 2020, Feng et al. (2021) found that an increase in confirmed cases does significantly raise exchange rate volatility. They also found that school closures, restrictions on internal movements, public information campaigns, income support, fiscal measures, and international aid all had an inhibiting effect on exchange rate volatility. Studying the efficiency of the exchange rate market over the period October 1, 2019 to 31 March 31, 2020, Aslam et al. (2020) found, among other things, a decline in the efficiency of forex markets during the COVID-19 outbreak. While Feng et al. (2021) used a system GMM estimation, Aslam et al. (2020) used multifractal detrended fluctuation analysis (MF-DFA) in their analysis.

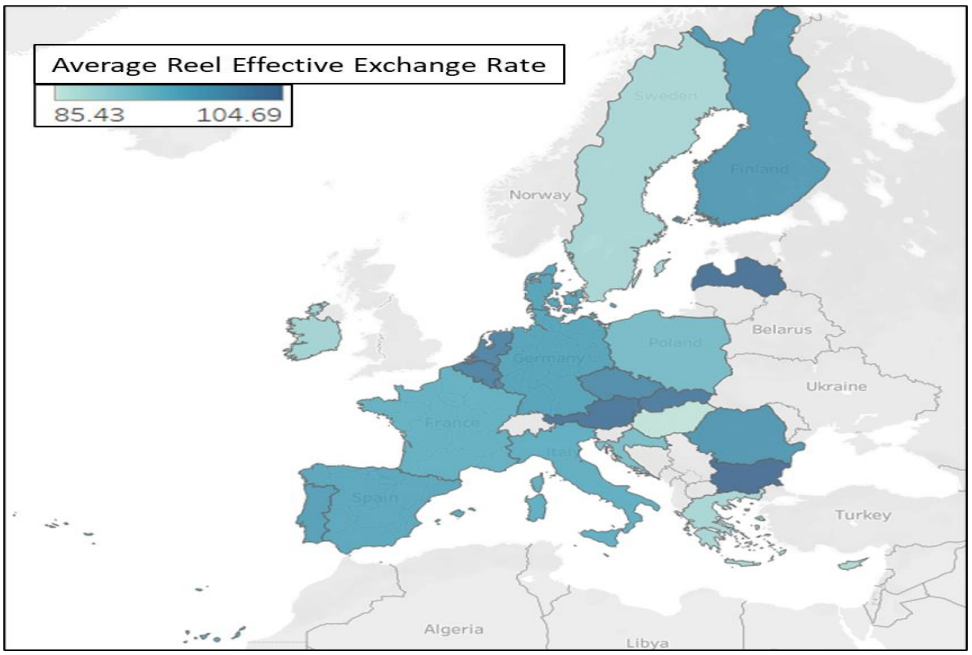
The reviewed literature reveals that there are limited studies on the impact of the COVID-19 response measures and the exchange rate in Europe despite the recognition that the impacts of such shocks are not symmetric in the sub-region. Those that studied the phenomenon – Feng et al. (2021) – considered the various measures in dealing with the pandemic in isolation, whereas most of the measures were applied as combined solutions in reality. As a result of these drawbacks, this study seeks to investigate the relationship between the composite measures instituted to deal with the pandemic and the exchange rate in Europe – recognising the fact that not all European countries have adopted the Euro as a domestic currency.

3. Data and methodology

The data for this study were sourced from the International Monetary Fund's (IMF's) international financial statistics and Our World in Data – a database for indicators on World problems. The data on the nominal exchange rate and the real effective exchange rate were sourced from the international financial statistics database. The data on the stringency index was sourced from the Our World in Data database. The stringency index is a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest). The nominal exchange rate used in this study is the National Currency Per U.S. Dollar, at the End of Period rate. The effective exchange rate used is the Real Effective Exchange Rate (REER) based on Consumer Price Index (CPI). According to the IMF's international financial statistics, it reflects continuous updating of weights and the incorporation of a larger set of trading partners. It replaces a previous estimate based on fixed-base weights from 2004–2006. The REER indices used in this study are calculated using weights updated every three years starting in January 2004. As mentioned earlier, the REER provides important information to market participants regarding the mix of foreign versus domestic goods on both the production and the purchasing side. An increasing REER will generally mean that a country is losing its competitive edge. External shocks – COVID-19 – will be expected to generally result in changes in the equilibrium real exchange rate of a country. If a country practices a fixed exchange rate regime, then this type of adjustment is expected to take place through changes in domestic prices (Edwards–Yeyati 2005). If there is a current account gap, it is usually closed by an exchange rate adjustment. A depreciation of the REER usually leads to an increase in the debt ratio. In this case, a fiscal adjustment may be

helpful. Due to data unavailability for Estonia, Lithuania and Slovenia, this paper studies 24 out of the 27 countries in Europe.

Figure 1 Distribution of Real Effective Exchange Rates in the EU during first year of COVID-19 (2020)



Source: Authors' construct

After conducting an ordinary correlation analysis, this study has tested for co-integration in the variables and accepted the null hypothesis of no cointegration in the study variables. As a result, a Dynamic Ordinary Least Square (DOLS) model is used for this study – with the dependent variable being the REER, and the independent variable being the stringency index. The study does not employ the models used by Aslam et al. (2020) and Feng et al. (2021) due to the nature and frequency of the variables used in this case. Also, because the interest rate of most countries in Europe are close to zero, the traditional approach for external balance assessment cannot be used in this study.

The DOLS model used here is an extension of the models proposed by Saikkonen (1992) and Stock and Watson (1993), which was applied to a panel data setting. This can be achieved by augmenting the panel cointegrating regression equation with cross-section specific lags and leads of ΔX_{it} to eliminate the asymptotic endogeneity and serial correlation. For the pooled DOLS estimator, an OLS method is used to estimate an augmented cointegrating regression equation of the form below.

$$y_{it} = X_{it}'\beta + \sum_{j=-q_i}^{r_i} \Delta X_{it} +'_j \delta_i - \upsilon_{1it} \quad (1)$$

Where y_{it} and X_{it} are the dependent and the independent variables purged of the individual deterministic trends. The short-run dynamics coefficients δ_i are allowed to be cross-section specific. The pooled DOLS estimator may be written as follows:

$$\begin{bmatrix}\hat{\beta}_{DP} \\ \hat{\gamma}_{DP}\end{bmatrix} = \left(\sum_{i=1}^{N}\sum_{t=1}^{T} W_{it}W_{it}{}'\right)^{-1}\left(\sum_{i=1}^{N}\sum_{t=1}^{T} W_{it}y_{it}{}'\right) \quad (2)$$

$$W_{it}{}' = (X_{it}{}', Z_{it}{}')' \quad (3)$$

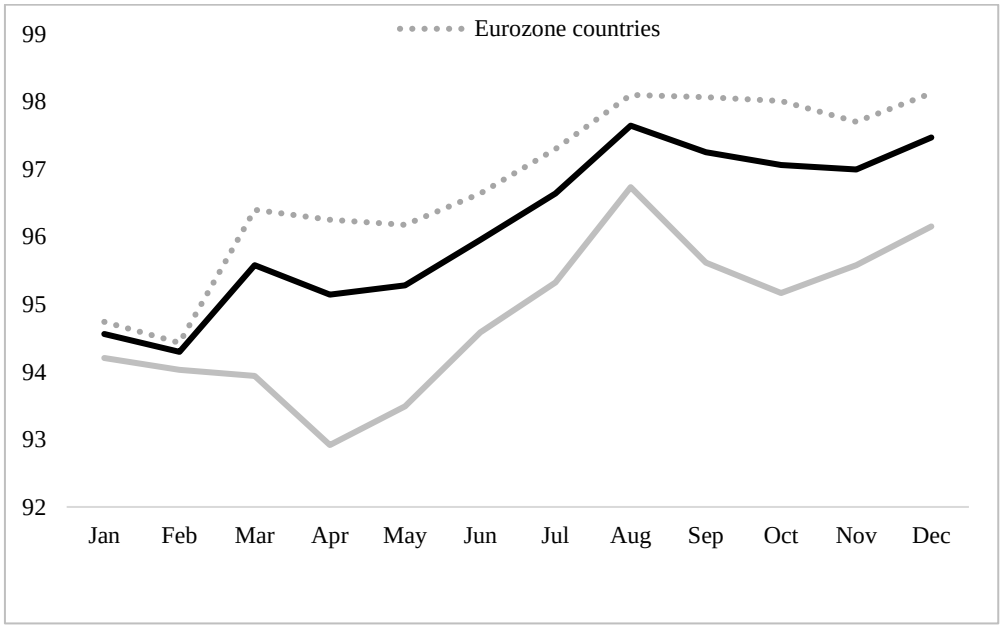
Where Z_{it} are the regressors formed by interacting the ΔX_{it+j} terms with cross-section dummy variables. All the variables are converted to their natural logs to reduce the effect of extreme variables.

4. Results and analysis

4.1. Performance of currencies of EU member countries during first year of COVID-19

First, the study used descriptive statistics to describe the average REER for each of the 27 EU member countries during the first year of the COVID-19 pandemic. It was found that Bulgaria (104.69), Latvia (104.23), Austria (103.55), Slovakia (102.60), and Belgium (101.5) had the highest REER, respectively, whereas Hungary (85.43), Cyprus (87.18), Sweden (87.73), Greece (87.744) and Ireland (88.38) had the lowest average REER during the first year of the pandemic (see Appendix, Table 2).

Figure 1 Trend of monthly Real Effective Exchange Rate for EU member countries during first year of COVID-19



Source: Authors' construct

Further descriptive analysis of the average REER for the EU member states has revealed that, on the average, the EU countries lost competitiveness as indicated by an REER of 96.16 during the first year of the COVID-19 pandemic. However, the Eurozone countries were more competitive than the EU countries that are yet to adopt the Euro as their national currency. In the early phase of the pandemic, EU countries using their national currencies gained competitiveness as they experienced a fall in their REER, however, over the one-year period they lost their competitiveness. This analysis does not, however, consider the relationship between the lockdown measures and the level of competitiveness in Europe (see Figure 1).

4.2. The impact of COVID-19 on the currencies of EU member countries

Correlation analysis conducted to determine if there was any significant relationship between the lockdown measures various EU governments used to limit the spread of the Coronavirus and the exchange rates of the respective EU member countries against the US dollar. The correlation analysis conducted has revealed a negative relation between the natural log of the nominal exchange rate and the REER over the first year of the pandemic. There was also a negative relationship between the natural log of the nominal exchange rate and the log of the stringency index over the study period – this relationship was however not significant. There was, however, a positive but significant relationship between the REER and the stringency index in the first year of the pandemic.

Table 1 DOLS long-run regression output for the REER

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNSINDEX	0.004541	0.000842	5.390479	0.00000
R-squared	0.963438			
Adjusted R-squared	0.955275			

Source: own construction

The results of the correlation analysis (see Appendix, Table 1) suggest that as countries in the EMU implemented stricter measures to deal with the pandemic, they lost competitiveness as the REER increased. This result is confirmed also by the DOLS regression result (see Table 1) as there was a significant and positive relationship between the log of the REER and the log of the stringency index in the studied countries in the first year of the pandemic. That is, a unit increase in the stringency index leads to 0.004541 increase in the REER – a loss in trade competitive – in the long run. This typically suggests that exports were more expensive than imports in the first year of the pandemic in the Euro area.

Table 2 Short-run analysis for the REER

	Intercept	D(LNSINDEX)
Austria	4.627	-0.005
Belgium	4.609	-0.014
Bulgaria	4.637	-0.004
Croatia	4.510	-0.002
Cyprus	4.451	0.003
Czech Republic	4.585	0.004
Denmark	4.558	-0.003
Finland	4.577	-0.013
France	4.537	-0.009
Germany	4.559	-0.012
Greece	4.456	0.003
Hungary	4.430	-0.001
Ireland	4.467	-0.006
Italy	4.541	-0.013
Latvia	4.633	-0.001
Luxembourg	4.600	-0.003
Malta	4.531	-0.010
Netherlands	4.605	-0.004
Poland	4.514	-0.006
Portugal	4.561	-0.010
Romania	4.580	-0.007
Slovakia	4.618	-0.005
Spain	4.551	-0.007
Sweden	4.467	-0.018

Source: own construction

The coefficients for the short-run dynamics show that the impact of the lockdown measure was diverse in the study countries. In the short-run only three of the 24 countries – Cyprus, the Czech Republic and Greece – lost their competitiveness as a result of the lockdown measures. This may also mean that the remaining 21 countries were able to close the current account gap in the short-run by allowing the exchange rate to adjust. A very important finding worth noting is that these three countries all have a floating exchange rate regime. The remaining 21 countries gained some competitive edge in the short-run as a result of the lockdown measures. This confirms studies by Funke (1997) and Sekkat and Mansour (2005) that the effect of shocks in Europe is asymmetric. The result is not conclusive in terms of the benefit or otherwise of belonging to the European Monetary Union (EMU) in the presence of a shock like COVID-19. A diagnostics test conducted for DOLS regression model rejected the null hypothesis of a normality test.

Conclusion

The review of the literature has shown that shocks affect countries in Europe differently, further hindering the adoption of the single currency by some members of the European union. Feng et al. (2021) and Aslam et al. (2020) confirm that the COVID-19 pandemic

is an economic shock with arguably no historical comparison. Due to its recent nature, there are limited studies investigating the impact of COVID-19 on the exchange rate of countries in the European Union. The few studies – Feng et al. (2021) – had considered the various measures in dealing with the pandemic in isolation, whereas most of the measures were applied as combined solutions. As a result, the present study has sought to investigate the impact of the stringency index – a measure based on nine response indicators including school closures, workplace closures, and travel bans – and the real effective exchange rate over the first year of the COVID-19 pandemic.

The results have shown that as lockdown measures intensified, countries in the EU lost their competitiveness in the long-run. In the short-run, however, only Cyprus, the Czech Republic and Greece lost their competitiveness as the lockdown measures intensified. The results have also confirmed the asymmetry of shocks in Europe, further questioning the benefits for countries seeking to join the EMU. That notwithstanding, on average, Eurozone countries (96.83) had higher REER when compared with EU member states that still use their national currencies (94.81) during the first year of the COVID-19 pandemic – indicating that competitiveness in the region was being driven by countries that have not adopted the Euro, although the performance of the currencies was not uniform across countries due to unique country specific factors. We, therefore, recommend that future studies should investigate the country specific factors that influenced the performance of the REER in the respective EU member states.

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Appendices

Appendix Table 1 Correlation analysis

	LNFX	LNREER	LNSINDEX
LNFX	1		

LNREER	–0.316	1	
	(–5.637)*	-----	
LNSINDEX	–0.030	0.107	1
	(–0.512)	(1.821)***	-----

*t-statistics in parenthesis (); Significance level: *1%, **5%, ***10%*
Source: own construction

Appendix Table 2 Real Exchange Rate Performance of EU Member countries during first year of COVID

Rank	Country	Currency	Average of REER
1	Bulgaria	National	104.69
2	Latvia	Euro	104.23
3	Austria	Euro	103.55
4	Slovakia	Euro	102.60
5	Belgium	Euro	101.55
6	Netherlands	Euro	101.25
7	Luxembourg	Euro	100.86
8	Czech Republic	National	99.98
9	Romania	National	98.73
10	Finland	Euro	98.23
11	Portugal	Euro	97.10
12	Germany	Euro	96.71
13	Denmark	National	96.69
14	Spain	Euro	96.12
15	Italy	Euro	95.01
16	France	Euro	94.72
17	Malta	Euro	94.02
18	Poland	National	92.78
19	Croatia	National	92.45
20	Ireland	Euro	88.38
21	Greece	Euro	87.74
22	Sweden	National	87.73
23	Cyprus	Euro	87.18
24	Hungary	National	85.43

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Skills demand, digital skills and skill formation in the European Union in the digital era

Laura Tandi

Developed economies have recently become more complex than ever before. As the European Union is transforming into a knowledge-based economy, more and more attention is paid to skill formation, in view of the fact that skills have become the most valuable resource in the twenty-first century, often available only scarcely for economic actors. All this implies that, in order to maintain and/or develop competitiveness of the European Union - as well as of the member states -, the knowledge capital base of an economy has to be developed and continuously maintained. Digital skills started to play an important role in the process and the COVID-19 pandemic has accelerated digital skills demand in many occupations, especially non-ICT ones. The aim of this paper is to examine the needs and the importance of digital skills in occupations across the EU through a literature review and descriptive statistics, and to outline possible solutions to develop digital skills use in this forming new ecosystem of economies, digital technologies and the humans operating and applying them.

Keywords: digital skills, competitiveness, knowledge-based economy, European Union

1. Introduction

In the twenty-first century an economy's power is strongly dependent not only on its size, the amount of raw materials available, or the size of the population. For societies and economies in the global economic competition new concepts such as education, training, culture and knowledge have become relevant. Already in 1957, Robert Solow revealed that something more was influencing the production function. He called it "technical change", divided it into two parts, and identified them as human capital and technological change (Solow 1987). Additionally, according to new paradigms in economics like endogenous growth theory, growth is due to indefinite investment in human capital (Barro–Sala-i-Martin 2004, Romer 1990). Moreover, technological development has accelerated, and information processing is constantly upgrading (Sulyok 2002). Developed economies have become more complex than ever before. Instead of being the labour force operating the physical infrastructure built from capital and thus producing the output of economic activities, people have developed into a 'human resource'.

All this implies that, in order to maintain and develop competitiveness in the European Union, the knowledge capital base of the economies of the member states has to be developed and continuously maintained (OECD 2012, Pelle–Laczi 2015). Information and communication technologies (ICTs) are at the core of this fast-changing global economy (van Laar et al. 2017). However, although ICTs are a foundation for innovation, in themselves they do not create a knowledge-based economy. Innovation starts with people, making the human capital within the workforce decisive (Anderson 2008, Kefela 2010, Lanvin–Kralik 2009, Lanvin–Passman 2008).

The current workplace requires highly skilled workers worldwide, faced with increasingly complex and interactive tasks. Employees do not only need excellent technical preparation; they also need sufficient skills to adapt to the changing requirements of the job (Ahmad et al. 2013, Carnevale–Smith 2013).

The development of the global knowledge society and the rapid integration of ICT make it imperative to acquire digital skills necessary for employment and participation in society (van Laar et al. 2017). Digitalisation has considerable impact on labour markets as well. New business models, products and machines create new jobs, while automation contributes to the elimination of jobs or their relocation to countries with lower labour costs. To remedy this situation in the European Union, developing the digital skills of the workforce is essential (Kiss 2017). Besides, digital skills are a major EU policy concern as figures in the information and communication technologies sector show that despite continued high levels of unemployment, the share of enterprises that found it hard to fill ICT specialist vacancies stood at 37% in 2013 and has risen to 58% by 2018 (Eurostat 2020). In the current economic situation of the digital era, a successful policy to foster the skills needed for a digital transformation could secure Europe a technological advantage and resilience in global competition (Kiss 2017). The outbreak of the COVID-19 pandemic has accentuated the digital skills gap between EU member states and the need to increase digital education (EP 2020), thus proving to be challenging for the European Union as well. After the imposing of nation-wide lockdowns, digital literacy turned out to be the key for continuing activities online (Akhvlediani 2021).

After defining digital skills within the 21st century skills, the paper discusses the measuring of those skills. The next section reveals the geographical and social distribution of digital skills at EU member state level and by age, gender and educational attainment, through processing available Eurostat datasets. The aim of this paper then is to reveal the impact of digitalisation in the EU labour market using the defined digital skills measurement categories and comparing the results with the 2015 data, thus tracing the last five year's trends. Finally, after examining the actions taken at the EU level to reach the digital transformation, the paper terminates with providing the conclusions of the information acquired from literature, data, and EU initiatives, and outlining the potentials for further improvement.

2. Twenty-first century skills and digital skills

Neither economic theory, nor applied economic policy should underestimate the importance of the human factor in productivity or the general success of any economic and social model. In fact, skills have become the most valuable resource in the twenty-first century, often being scarcely available for economic actors (Mayer–Solga 2008). The formation of the concept of 21st century skills was preceded by a discussion at the turn of the 21st century, regarding what kind of skills and understanding citizens must have in the knowledge society (Csapó 2019). However, 21st century skills are not necessarily underpinned by information and communication technologies, and digital skills are considered as a more practical tool to understand and to use information from a variety of digital resources, so there is a close connection between the two concepts (van Laar et al. 2017).

2.1. Twenty-first century skills

At the turn of the 21st century three IT companies, Cisco, Intel and Microsoft launched a comprehensive project to define those desired skills of the new "digital era" and to get them measurable (Csapó 2019). The working group published those ten 21st century skills – grouped in four categories – in a measurable form (Binkley et al. 2012). The first category, "Ways of Thinking" includes three skills such as *Creativity and Innovation*, *Critical Thinking, Problem-solving, Decision-making* and *Learning to learn, Metacognition*. The category of "Ways of Working" subsumes *Communication* and *Collaboration or teamwork*, while "Tools for Working" category incorporates *Information literacy* and *Information and Communication Technology (ICT) literacy*. The fourth category, known as "Ways of Living in the World" is comprised of *Citizenship* (local and global), *Life and career*, and *Personal and Social responsibility*.

Table 1 The twenty-first century skills

WAYS OF THINKING	•CREATIVITY AND INNOVATION •CRITICAL THINKING, PROBLEM-SOLVING, DECISION-MAKING •LEARNING TO LEARN, METACOGNITION
WAYS OF WORKING	•COMMUNICATION •COLLABORATION OR TEAMWORK
TOOLS FOR WORKING	•INFORMATION LITERACY •ICT LITERACY
WAYS OF LIVING IN THE WORLD	•CITIZENSHIP (LOCAL AND GLOBAL) •LIFE AND CAREER •PERSONAL AND SOCIAL RESPONSIBILITY

Source: own construction based on Binkley et al. (2012)

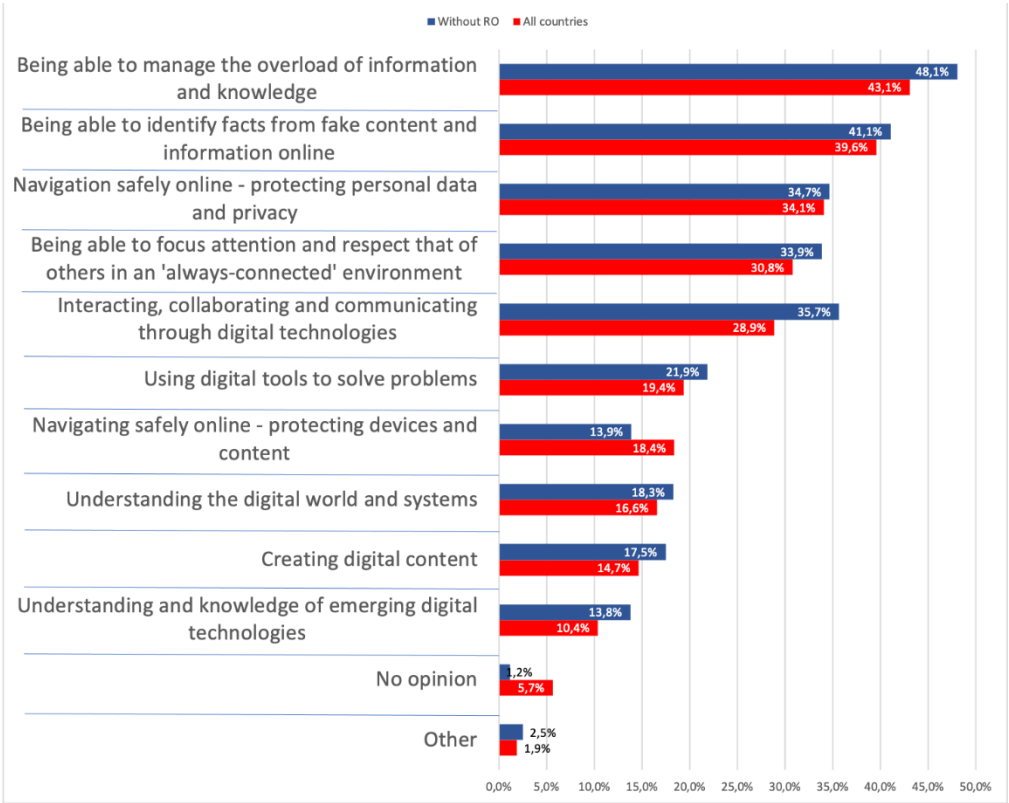
In 2016, based on The World Economic Forum report – Future of Jobs – the ten leading skills of 2020 were predicted (Zahidi and Leopold 2016). In the list of the top ten skills the first three are from the list above, specifically complex problem solving, critical thinking and creativity. In the VUCA (Volatile, Uncertain, Complex, Ambiguous) world these key 21st century skills are essential to live in and manage our lives successfully (Fadel et al. 2015).

2.2. Digital skills

21st century skills and digital skills are both concepts that emphasize a broad spectrum of skills (van Laar et al. 2017). It is essential to define digital skills and see their place related to the 21st century skills as indispensable to live in the digital era. Digital skills encompass a range of basic to highly advanced skills that enable the use of digital

technologies and, in addition, all basic cognitive, emotional or social skills necessary for the use of digital technologies (Kiss 2017). It is also important to share the definition of digital literacy or digital competence as they are often used synonymously to describe digital skills. Digital literacy or competence is the ability to find, evaluate, utilize, share and create content using information technologies and the Internet (Cornell University 2015). Thus, digital literacy must be more than the ability to use digital sources effectively, it is a mind-set that enables users to perform intuitively in digital environments, and to both easily and effectively access the wide range of knowledge embedded in such environments (Martin 2008).

Figure 2 Most important digital skills and competences for living and working in the 21st century



Source: own construction based on OPC consultation on the new Digital Education Action Plan 2020

The European Commission launched an Open Public Consultation (OPC) with the aim to ensure that the new Action Plan – Digital Education Action Plan 2021–2027 – would draw lessons from the experiences during the COVID-19 crisis and would support education and training through the long-term digital transformation. The results of the

OPC are shown on *Figure 2*. Ministries of Education and the Members of the European Parliament stressed the need to address the issue in a strong life-long learning and inclusive perspective, equipping young people and adults with the skills to engage with information critically (EC 2020a). The results in the OPC were parallel to all the previous definitions of digital skills and digital literacy, stressing that in the digital era it is indispensable to possess digital skills because digital technologies are inevitable both in people's professional and personal lives.

21st century skills and digital skills they are strongly intertwined, as *Critical Thinking* is needed to manage the overload of information and knowledge and to identify facts from fake content and information online. Or the use of digital tools can make Problem-solving more successful as well as understanding the digital world and systems and understanding and knowledge of emerging digital technologies are part of the ICT literacy.

Low levels of digital skills pose risks and act as a barrier to social inclusion. EU "citizens' exposure to large-scale disinformation, including misleading or false information, is a major challenge for Europe and it has become even more evident with the COVID-19 crisis. The virus outbreak dominated the media and it has been accompanied by an 'infodemic', a term indicating a massive amount of information that has made it hard for people to find trustworthy sources and reliable guidance. The need for all citizens to have a critical understanding of and interaction with the media and digital environments, to become resilient to disinformation and improve their participation in democratic processes has never been as vital as it is in today's digital world" (EC 2020a, 44.).

2.3. Measuring digital skills

The European Commission launched the Digital Competence (DigComp) Framework in 2011 to produce a set of digital competence descriptors for all levels (Kiss 2017). Based on DigComp, the Commission Directorate General for Communications Networks, Content and Technology and the Eurostat Information Society Working Group agreed to create and publish a 'Digital Skills Indicator', in 2014 (Kiss 2017).

According to the Eurostat description, digital skills indicators are composite indicators which are based on selected activities related to internet or software use performed by individuals aged 16–74 in four specific areas (information, communication, problem solving, software skills). It is assumed that individuals having performed certain activities have the corresponding skills. Therefore, the indicators can be considered as proxies of the digital competences and skills of individuals (Eurostat 2021).

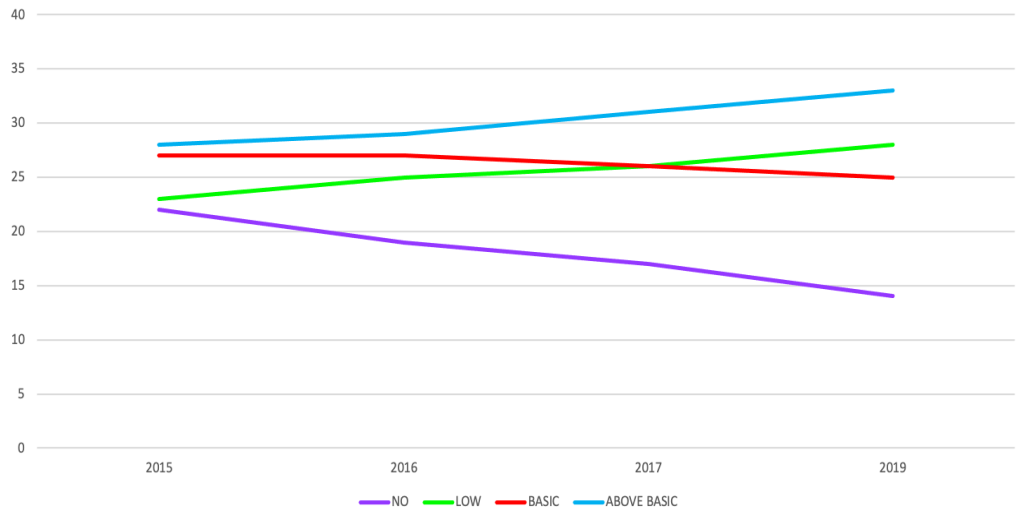
In line with the variety or complexity of activities performed, two levels of skills (basic and above basic) are computed for each of the four dimensions. Finally, based on the component indicators, an overall digital skills indicator is calculated as a proxy of the digital competences and skills of individuals (no skills, low, basic or above basic) (Eurostat 2021). The figures are also merged into the Digital Economy and Society Index (DESI), which is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU member states in digital competitiveness (EC 2020b).

3. Distribution of digital skills in the European Union

This section discusses two main types of distribution of digital skills in the EU to demonstrate the current state of digital skills level: geographical (member states level) and social distribution. Among social differences the paper reveals gender-specific, age-specific peculiarities and the distribution of individuals by educational attainment.

The overall picture is summarized in Figure 3. The share of individuals with no digital skills decreased by 8% from 22% in 2015 to 14% in 2019 and those individuals from 2015 might acquire digital skills as the share of individuals with low digital skills increased by 5%, from 23% in 2015 to 28% in 2019. This growth is less that the decrease of the share of people with no digital skills, because those people with low digital skills in 2015 might obtain enough knowledge to have basic digital skills in 2019.

Figure 3 Digital Skills Indicator by digital skills level in the EU between 2015–2019



Source: own construction based on Eurostat data (2021)

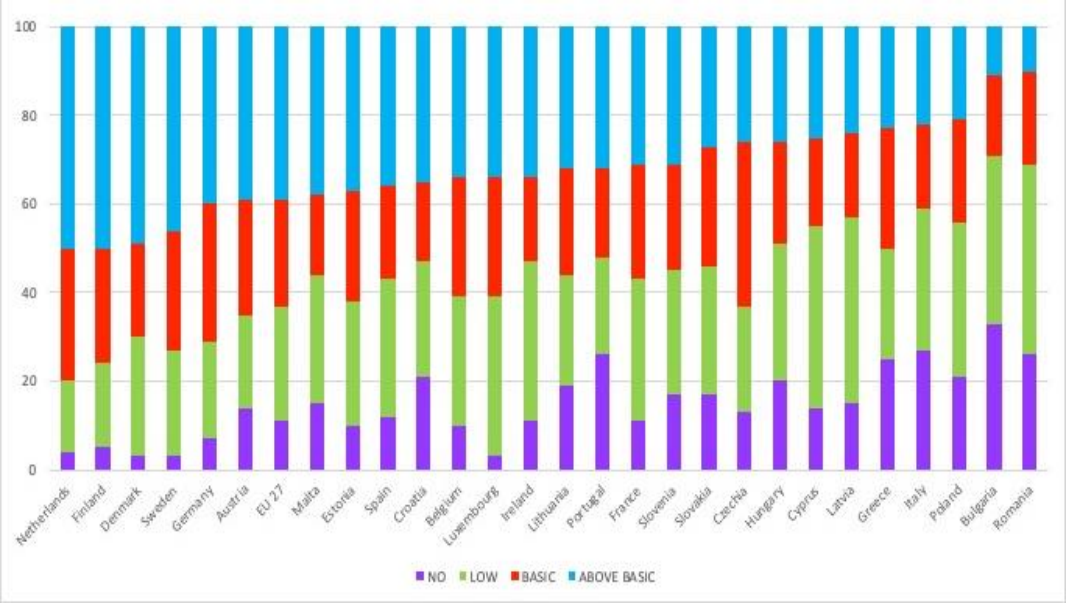
The situation is similar with basic and above basic digital skills as well. The share of individuals with basic digital skills decreased by 2%, from 27% to 25%, and the share of individuals with above basic digital skills raised by 5%, from 28% to 33%. This increase is more than the decrease in the rate of people with basic digital skills because those people with low digital skills in 2015 could have the knowledge needed in 2019 and thus could obtain basic digital skills.

The share of EU citizens with basic or above basic digital skills was 58% in 2019, while the rate of EU citizens with no or low digital skills is 42%, which means that almost the half of the EU population do not have enough digital skills to manage their lives in the digital age.

3.1. Geographical distribution of digital skills in the European Union

According to the Digital Skills Indicator from 2019 (Figure 4), 11% of Europeans (in the 27 EU countries) can be considered as having no digital skills, based on the criterion that they are not using the internet. It ranges between 3% (Denmark and Sweden) and 33% (Bulgaria).

Figure 4 Distribution of all individuals in EU member states by digital skills level in 2019, %



Source: own construction based on Eurostat data (2021)

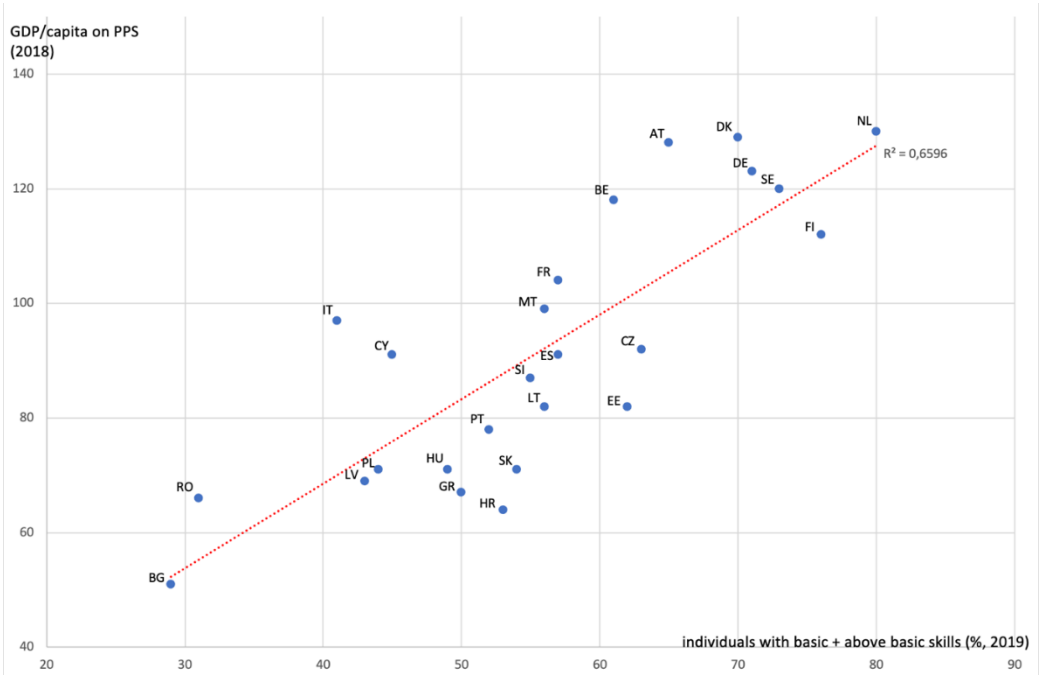
While in 2015 30% or more of the population had no digital skills in eight countries (Bulgaria, Croatia, Cyprus, Greece, Italy, Poland, Portugal, and Romania), in 2019 only Bulgaria and Italy had populations with around 30% having no digital skills, and the other mentioned countries were between 20 and 25%. Compared to the 2015 data, where 21% of EU citizens had no digital skills, it is noticeable that Europeans are acquiring digital skills.

To function in a digital society, an individual needs more than low-level skills (Kiss 2017). Considering this statement 37% of EU citizens lack enough digital skills – having no or low digital skills – even though 21 member states out of 27 have even higher shares. The arear is Bulgaria where this rate is 71%, followed by Romania and Bulgaria, and the most outstanding member states are the Netherlands (20%), Finland (24%) and Sweden (27%).

When constructing a scatterplot (Figure 5) with the GDP per capita of the EU member states and the share of individuals having enough digital skills (basic and above basic) to live and perform in thedigital age, the results clearly show that there is significant correlation (R^2=0.6596) between the two examined variables. Therefore,

the higher the level of digital skills of a population in an EU member state, the more likely it is to be paired with higher value of GDP per capita.

Figure 5 EU member states' GDP per capita as a function of the share of individuals having basic and above basic level of digital skills



Source: own construction based on Eurostat data (2021)
Note: Ireland and Luxembourg were eliminated from the variables because of their outlier value of GDP/capita and their small population

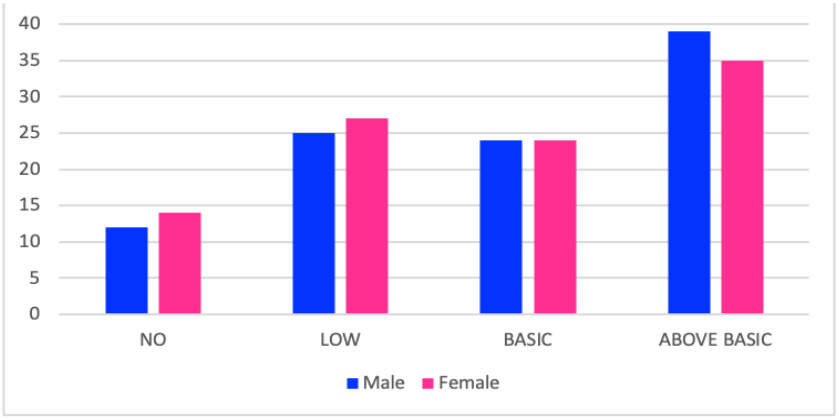
Furthermore, several other conclusions can be made after examining the figure. Values of EU member states vary in a wide range, both in terms of the share of individuals with basic and above basic skills (from 29% to 80%), and in terms of the value of GDP per capita on purchasing power standard (from 51 to 130). Two or three main groups can be defined based on the trend line: Western and Northern European member states are located at the upper end of the trend line, while member states at the Eastern and Southern periphery are located at the lower end of the trend line, with Bulgaria and Romania lagging behind.

3.2. Gender distribution of digital skills in the European Union

In the European Union, men often have greater advantages than women when it comes to the digital skills necessary to thrive in the digitalised world of work (EIGE 2020).

Figure 6 demonstrates that the share of men only exceeds the share of women in above basic digital skills, which means that the higher the level of digital skills we look at, the higher the share of men.

Figure 6 Digital skills by gender in the EU in 2019, % of individuals



Source: own construction based on Eurostat data (2021)

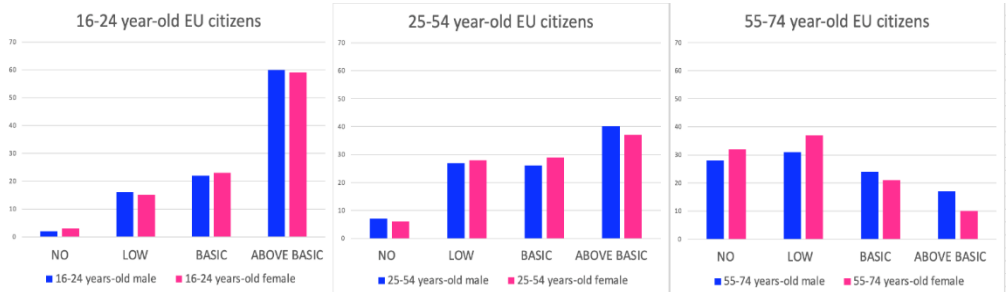
3.3. Age distribution of digital skills

To complement gender differences to measure digital skills distribution, age grouping can play an important role.

Figure 7 shows more social differences regarding digital skills in the European Union. The 2019 Eurostat survey demonstrates slight differences between the 16-24- and 25–54-year-old groups, the digital skills of men and women between 16–54-year-olds are quite the same.

The youngest age group – 16–24-year-old EU citizens – represents generation Z, which is the first social generation to have grown up with access to the Internet and portable digital technology, and is often called as "digital natives" (Zarándy 2012). As shown in Figure 7, 60% of male and 59% of female digital natives have above basic digital skills, and almost the entire generation Z has at least low digital skills (males 98%, females 97%) while 82% of both male and female 16–24-year-olds have satisfactory – basic and above basic – digital skills.

Figure 7 Digital skills of men and women in different age groups in 2019, % of individuals



Source: own construction based on Eurostat data (2021)

Examining the active age group, 25–55-year-old EU citizens, it can be stated that more men have above basic skills (40%) than women (37%), but if we compare the basic or above basic digital skills in the two gender groups, we find that their rate is the same (66-66%). However, it should be noted that one third of both active males and females currently in the labour market do not have enough digital skills (no or low categories) to live and perform in the digital society.

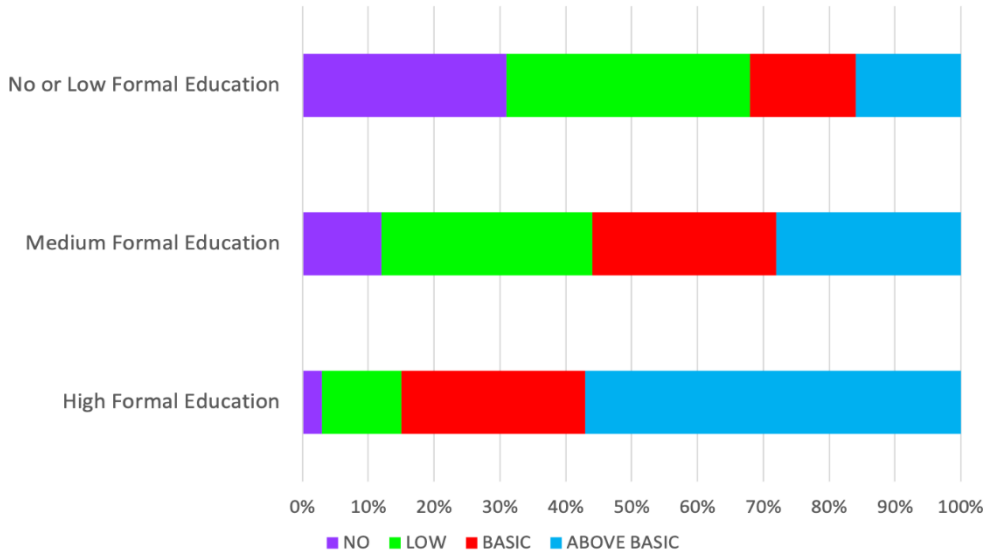
The elderly population – 55–74-year-old EU citizens – is characterised by insufficient digital competences, although the retirement age is 65 (and rising) in most of the member states, so they would need training to keep abreast of the times.

It may look like there will be no problem regarding the obtainment of higher digital skills as almost 60% of the 16–24-year-old population has above basic digital skills, but this paper has not examined the change in the share over time in the age groups. It can be possible that having children, certain social traditions, or other factors may affect the development of women's digital skills negatively.

3.4. Educational attainment and the digital skills indicator

The base of a knowledge economy is the ability of innovation and the ability of learning (Tamási 2006). As is well known, the correlation between higher qualifications, developing knowledge capital and the competitiveness of the economy is relevant (Vass 2020). "The EU considers continuous advancement of education and training to be of profound importance. Widespread access to quality education and training is a driver of economic growth, social cohesion, research and innovation – and dramatically increases citizens' prospects for personal development" (EC 2021a).

Figure 8 Distribution of individuals in the EU with various educational attainment levels by level of digital skills in 2019, %



Source: own construction based on Eurostat data (2021)

It is worth examining if there is any relationship between the level of the educational attainment of an individual and the level of their digital skills. First, the levels of formal education have to be defined. Three main levels of educational attainment are distinguished in this section: no or low formal education, which means someone has only pre-primary, primary and lower-secondary education or no education at all. Medium formal education level corresponds to upper secondary and post-secondary non tertiary education, and high formal education refers to tertiary education (Kailis and Pilos 2005).

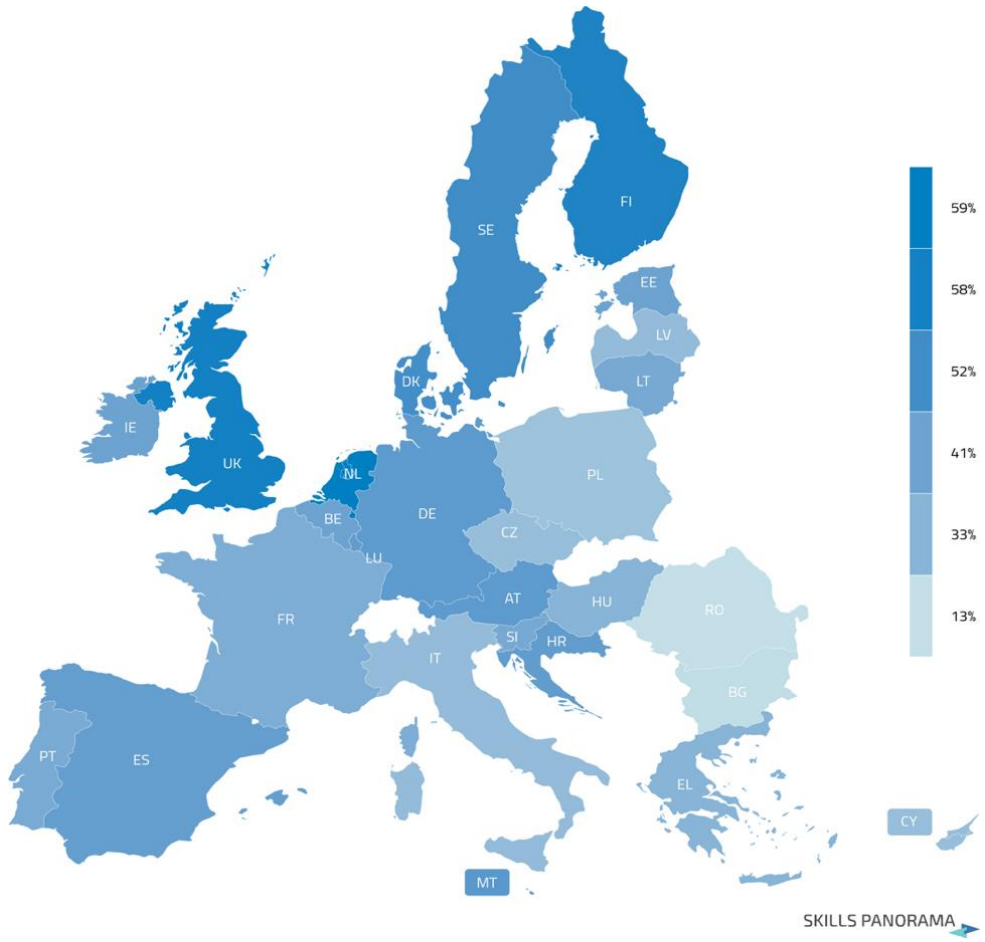
Figure 8 shows the share of individuals with different digital skills by educational attainment. Apparently, the level of educational attainment is directly proportional to the level of digital skills possessed. While 68% of individuals with no or a low level of formal education had no or low digital skills in 2019, 85% of EU citizens with high formal education level had basic or above basic digital skills and moreover, 67% of them had above basic level in digital skills. As a result of the comparison the conclusion is clear that the higher the level of education someone has, the more digital skills someone possesses. Thus, the formation of the EU 'competitiveness union' is crucial and urgent (Pelle 2013), and it is now inevitable to the population of Europe to be highly educated with good access to information and to relentlessly focus on training (Demeter et al. 2011).

4. Digital skills in the EU labour market

While basic digital skills, such as the use of search engines or digital bank services, are necessary, advanced digital skills open opportunities for access to well-paid jobs for which there is significant demand in the European digital economy (EIGE 2020). Skills Panorama is developed by the European Commission, the Directorate General for Employment, the Social Affairs and Inclusion powered by Cedefop, the European Centre for the Development of Vocational Training. The project turns labour market data into accurate and timely intelligence to offer new insights into skill needs in the European Union (Skills Panorama 2021a). Skills Panorama created the Digital skills use indicator (Figure 9), which provides the share of people whose digital skill use is above basic.

According to Skills Panorama research, the demand for digital skills is high in the EU labour market. A rapid digital transformation took place in some sectors like finance, business administration, science and engineering, education, health care, trade and manufacturing, and in line with this transformation, digital skills become relevant in managerial, professional and even in clerical occupations as well. It is also noticeable that other types of work tasks are also linked to ICT tasks. As already highlighted, 21st century skills and digital skills are strongly related, and digital skills can help improve those skills for adapting in the field of work. Online job advertisements (OJAs) have become the main platform for employers and job-seekers during COVID-19 pandemic and the growing importance of digital skills and knowledge in OJAs during 2020 is a sign of progressing workplace digitalisation (Skills Panorama 2021b).

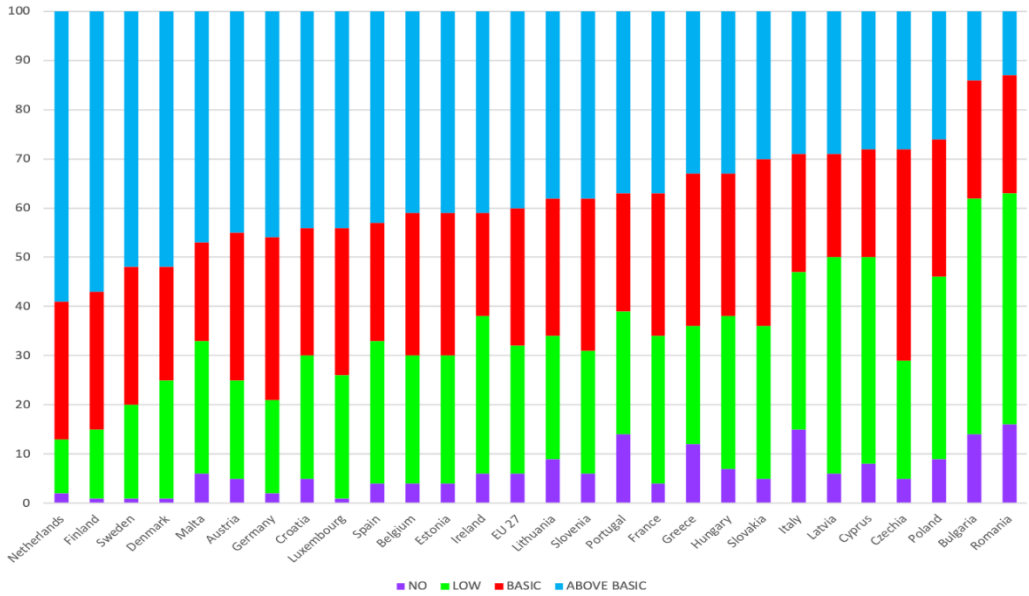
Figure 9 Share of all in employment in 2019 with above basic digital skills across European countries



Source: Skills Panorama (2021)

According to Eurostat data (Figure 10), 6% of EU workforce had no digital skills at all in 2019. The worst performing member states with shares above 10% were Romania (16%), Italy (15%), Portugal (14%) and Greece (12%). In addition, 32% of EU labour force had insufficient (no or low) digital skills and this share is higher in 15 member states, where Bulgaria (63%) and Romania (62%) performed the worst as more than half of their employed population lacked at least basic digital skills. Comparing these data to 2015, the progress is measurable, though, as Bulgaria improved by 1% in 4 years' time and Romania reduced the 70% share to 62%. Although it should be mentioned that the level of digital skills of the EU working population is higher than that of the whole population.

Figure 10 Distribution of EU labour force* by digital skills level in 2019, %



Source: own construction based on Eurostat data (2021)
**Note*: labour force includes employed population, self-employed population and family workers

Digitalisation has a great impact on the labour market as well. New business models, products and machines create new jobs, while automation contributes to the elimination or destruction of jobs or their relocation to countries with lower labour costs (Kiss, 2017), and the workplaces most affected are the medium-skilled jobs (Csapó, 2019). Without the right amount of digital skills, it would be difficult for an unemployed individual to re-enter the labour market.

5. Actions improving digital skills level of the EU population

The different pace of digitalisation of the EU member states is a real concern, causing a widening digital skills gap. Skills, labour mobility and information technologies are part of EU policy (among other things), they are key essentials in achieving desired competitiveness level in the world. Skills upgrading is not just a luxury for the highly qualified high-tech professionals, but a necessity for everyone (Kiss 2017). The digital skills gap – expanding as a result of the outbreak of COVID-19 pandemic – required an increase in digital education (EP 2020), thus proved to be challenging for the European Union as well. Several initiatives at the EU level have been taken to remedy this situation.

Education as an investment in human capital is an indispensable precondition to attract financial capital as well. Actions at the EU level also stress the importance of education in the process of digital transformation. All the mentioned EU programmes prioritise financial and non-financial investments in education. The main question is

how motivating financial assistance can be for the EU member states, and what other tools can be used to encourage the development of digital skills at member states' level since the success of these measures may be questionable without the contravention of the sovereignty of the member states.

Table 2 EU actions to improve digital skills level of the EU population

INITIATIVE	ENCOMPASSING PROJECT	PERIOD	RESOURCE	OBJECTIVES CONCERNING DIGITAL SKILLS
2010 Digital Agenda for Europe	Europe 2020	2010-2020	commissions	- enhancing digital literacy skills and inclusion - applying ICT to address societal challenges such as climate change and ageing population
Skills Guarantee	New Skills Agenda	2016	funds from enterprises and governments	helping the access to upskilling for those who have left initial education to acquire a minimum level of literacy, numeracy and digital skills
Digital Europe Program	EU budget	2021-2027	€580 million	- supporting the design and delivery of specialized programmes and traineeships for the future experts in key capacity areas like data and AI, cybersecurity, quantum and HPC - supporting the upskilling of the existing workforce through short trainings reflecting the latest developments in key capacity areas
The Recovery and Resilience Facility	NextGenerationEU	2021-	€672.5 billion (initiative; loans & grants)	reskilling and upskilling by education and training to support digital skills
European Skills Agenda	-	2020-2025	funds from enterprises and governments	raising the share of adults aged 16-74 having at least basic digital skills from 56% (2019) to 70%
Digital Education Action Plan	-	2021-2027	commissions	- fostering the development of a high performing digital education ecosystem - enhancing digital skills and competences for the digital transformation

Source: own construction based on EC initiatives (2021)

Prior to the current crisis induced by the pandemic, as part of the Europe 2020 strategy for smart, sustainable and inclusive growth, the *2010 Digital Agenda for Europe* was already among its seven flagships and some of its priority areas were focusing on enhancing digital literacy skills and inclusion, and applying ICT to address societal challenges such as climate change and an ageing population (EC 2010). In 2014, more than 90% of the actions were completed already (Kiss 2017). In 2016, New Skills Agenda aimed to improve the quality of skills throughout the whole spectrum of education. Within the agenda, the *Skills Guarantee* was launched to provide access to

upskilling for those who have left initial education to acquire a minimum level of literacy, numeracy and digital skills (EC 2016).

The *Digital Europe Program* 2021–2027 is part of the next long-term EU budget – with a budget of 7.5 billion EUR – to accelerate the recovery and drive the digital transformation of Europe (EC 2021b). Among other outcomes, it will strengthen investments in advanced digital skills with 580 million EUR by supporting the design and delivery of specialized programmes and traineeships for the future experts in key capacity areas like data and AI, cybersecurity, quantum and HPC and by supporting the upskilling of the existing workforce through short trainings reflecting the latest developments in key capacity areas (EC 2021b).

NextGenerationEU is a temporary instrument that allows the European Commission to raise funds to help repair the immediate economic and social damage brought about by the COVID-19 pandemic (EC 2021c). *The Recovery and Resilience Facility* is the key instrument at the heart of NextGenerationEU with a budget of 672.5 billion EUR and one of its flagship areas for investments and reforms is to reskill and upskill by education and training to support digital skills.

The *European Skills Agenda* is a five-year plan to help individuals and businesses develop more and better skills and to put them to use (EC 2021d). One of the objectives to be achieved by 2025 is to raise the share of adults aged 16-74 having at least basic digital skills from 56% (2019) to 70%.

The *Digital Education Action Plan* 2021–2027 outlines the European Commission's vision for high-quality, inclusive and accessible digital education in Europe (EC 2021e). The Action Plan "addresses the challenges and opportunities for digital education in different learning environments – formal, non-formal and informal – and extends its scope to lifelong learning" (EC 2020a, 23). Its priority areas are fostering the development of a high performing digital education ecosystem, and enhancing digital skills and competences for the digital transformation.

To sum up, we can state that the European Union has acknowledged the importance of digital skills in the global technology-driven competition, and the relevance of improving digital skills among the EU population and labour force is prevalent in an ever wider scope of EU initiatives and actions. In addition, digital competences and performance of individuals is more and more linked to European competitiveness.

6. Conclusions and room for improvement

The digital transformation of the world is inevitable and the only question for an economy is the pace of its adaptation. In the current economic situation of the digital era, a successful policy to foster the skills needed for a digital transformation could secure Europe a technological advantage and resilience in global competition. The European Union has a leading role in shaping the global economy in the 21st century and, thus, has to progress to keep its competitiveness. As Pelle and Laczi (2015) found, an inclusive society is a necessary precondition for a competitive economy in the EU, but low levels of digital skills pose risks and act as a barrier to social inclusion, which is a great concern as 42% of EU citizens – almost half of the EU population – do not have sufficient digital skills to manage their lives in the digital era.

The analysis of data reveals relevant differences in digital skills levels across EU member states and across various social groups. The share of individuals with basic and above basic digital skills in EU member states varies between 29%-80%, which is a noticeable difference and confirms the centre vs. periphery contrast, as the core countries tend to account for the higher shares, while the periphery countries exhibit the lower ones. Examining the group of men and women, the higher the level of digital skills we analyse, the higher the share of men in the digital skills level group.

This paper has not focused on the change in the share of individuals at different digital skills levels over time, but motherhood, certain social traditions and further socio-cultural factors may affect the development of women's digital skills negatively. Moreover, one third of both active males and females does not dispose of sufficient digital skills to successfully participate and perform in the digital society and in the EU labour market, which harms EU competitiveness as well. As shown above, the higher the level of digital skills of a population in an EU member state, the more likely it is to be paired with a higher value of GDP per capita. Presumably, the development of people's digital skills could have a positive effect on the GDP per capita of a member state and, thus, could increase the competitiveness of the European Union on the global market. As the European Union has recognized this impact, numerous initiatives have been launched, already discussed in the fifth section of the paper. It comes up against a difficulty to identify the method of developing the overall status of the digital skills of the European population by EU level initiatives, and compared to that, it is gratifying that a number of programs have been launched and several funds have been created trying to solve the disputed point. Another engaging question is whether the European Union would have recognized the importance of digital skills without a pandemic.

Accordingly, both the EU and its member states should place a special emphasis on policies and programmes that aim at improving digital skills of the population and the labour force, especially on the lower end, as the individuals in those groups are at serious risk of social and labour market exclusion. Targeted local and broader programmes and projects for women, elderly age groups, and people with lower educational attainment would contribute to the narrowing of the digital skills gap in the EU. Obviously, regular education systems of the member states should embrace digital technologies and the preparation of the students for applying them in various subject fields. So, the improvement of digital skills should be a horizontal intervention in education and training systems and initiatives.

Development of digital skills is therefore essential, and even more so in the situation caused by the COVID-19 pandemic from 2020 onwards, which might act as trigger to boost actions. The skilling, upskilling and reskilling processes should tend to narrow the digital skills gap across the EU member states as well. The process of converging digital skills should result in an "upward-convergence", in other words, while training and educating underperforming EU member states and social groups to reach the level of highly performing ones', those outstanding actors (member states and social groups) have to maintain their leading positions in terms of digital skills attainments. Further research is required to explore the actions for the development of digital skills already implemented by the EU member states.

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The impact of digitalization on unemployment: The case of the Nordic countries

Violetta Ivanitskaia

The topic of digitalization has a high relevance in the literature nowadays, where many authors try to figure out the impact of digitalization on the labour market in the short and long terms. Some authors argue that the process of digitalization creates new jobs, whereas others claim that it increases unemployment. The Nordic countries, such as Iceland, Finland, Norway, Denmark and Sweden are the leading countries in terms of digitalization on the European continent, and the estimation of an impact of digitalization on unemployment has a high relevance for these countries. The paper assesses the impact of digitalization on the unemployment rate in the Nordic countries with help of the robust OLS regression in STATA, for the period of 1991–2019. Results show that digitalization on average has a high significance and a negative association with the variable of unemployment. The increase of the variable of digitalization by 1% on average leads to a decrease in the unemployment rate by 0.025% in the Nordic countries.

Keywords: Digitalization, labour market, ordinary least squares regression, the Nordic countries, unemployment.

1. Introduction

The labour market can be affected by many factors, including the level of development of institutions, for example, trade unions, the educational system, social security, demography and migration, and digitalization is one of the important factors too. The process of digitalization can be defined as the transformation of all sectors of the economy, government and society based on the adoption of digital technologies. According to Manyika et al. (2013) the existing digital technologies are the internet of things, artificial intelligence, and mobile internet. There are also technologies which have not been adopted yet, for example, 3D printing and next generation genomics. Digitalization was promoted by the increase in internet connections at the end of the 1990s and was further developed by the high-speed internet and mobile data access. According to Sabbagh et al. (2013), digitalization is the mass adoption of connected digital services by consumers, enterprises, and governments, which promotes growth and job creation. Digital technologies affect the computerization of production, service delivery and even the private sphere. According to Frey and Osborne (2013), the development of the areas, such as machine learning, mobile robotics and artificial intelligence will further stimulate a computerization of the economy. Due to digital technologies, electronic devices connect people, machines with workers and machines with machines. The process of digitalization already affects our daily life and the world economies. Digitalization drives entrepreneurial innovation, productivity and economic growth. According to Solow (1956), technological change is important for economic

growth and productivity. Due to digitalization more output can be produced with given input, or the same amount of output can be produced with less input. Digital technologies can also bring new products and services to the market.

The topic of digitalization has a high relevance in the literature nowadays, where many authors try to figure out the impact of digitalization on the labour market in the short and long terms. The process of digitalization affects the structure of the labour market and can create many new jobs on the market and at the same time cause problems such as the persistence of unemployment because of skill gaps and inequality. Therefore, such structural changes in employment can be either positive or negative.

Some authors argue that the process of digitalization will create new jobs, whereas others claim that the long-term digital revolution will increase unemployment. According to Eichhorst and Spermann (2016), the existence of various internet platforms creates new services and jobs and stimulates a demand on the market. According to Hong and Chang (2020), since the introduction of internet technology in China in the 1990s, the degree of informatization has improved rapidly. The Chinese government has implemented a few development strategies, such as "Smart City", "Internet Plus" and "Digital China," where the main goal of the government was the popularization of internet technologies in society. Authors examined how digitalization influenced the economic welfare of forest farm families, where under digitalization authors have considered the internet use by the households. They found that compared with non-internet users, internet users have 28% higher household income and 10% higher life satisfaction. At the same time according to Brynjolfsson, McAfee (2011), technologies are able to replace not only jobs with routine tasks as well as with non-routine tasks which require high skills. Rifkin (2014) argues that the long-term digital revolution will reduce employment. According to him, even a low-paid worker will be more expensive than the additional cost of using a machine. As a result, there will be a growth in jobs for innovative products and a decline in jobs for standard products. A significant contribution to this topic was provided by Frey and Osborne (2013), who forecasted the situation on the labour market in 10–20 years. With the help of experts, they estimated the future of 702 jobs in the United States. The model predicts that about 47% of all employment in the United States will be under the threat of replacement by machines, robots or computer programs. According to the authors, jobs related to logistics, transportation, office and administrative support have the highest risk of automation, and jobs which require lower skills have a higher chance of automation. Autor and Dorn (2013) argue that the structure of the labour market will change, but jobs will not disappear. According to them, not only the level of skills can determine the risk of automation, but the character of jobs as well. For example, routine tasks have a higher chance of being replaced by robots. Hanush (2016) supports this idea and points out that the technological revolution will change fundamentally essential characteristics of the three pillars which constitute a socio-economic system: the financial, the public and the real sector.

As we can see, there is still no consensus in the literature regarding this question nowadays. Some authors argue that the process of digitalization will create new jobs, whereas others claim that the long-term digital revolution will increase unemployment. This topic needs further investigation, and in this paper, I have considered the case of the Nordic countries. The Nordic countries, which include Iceland, Finland, Norway,

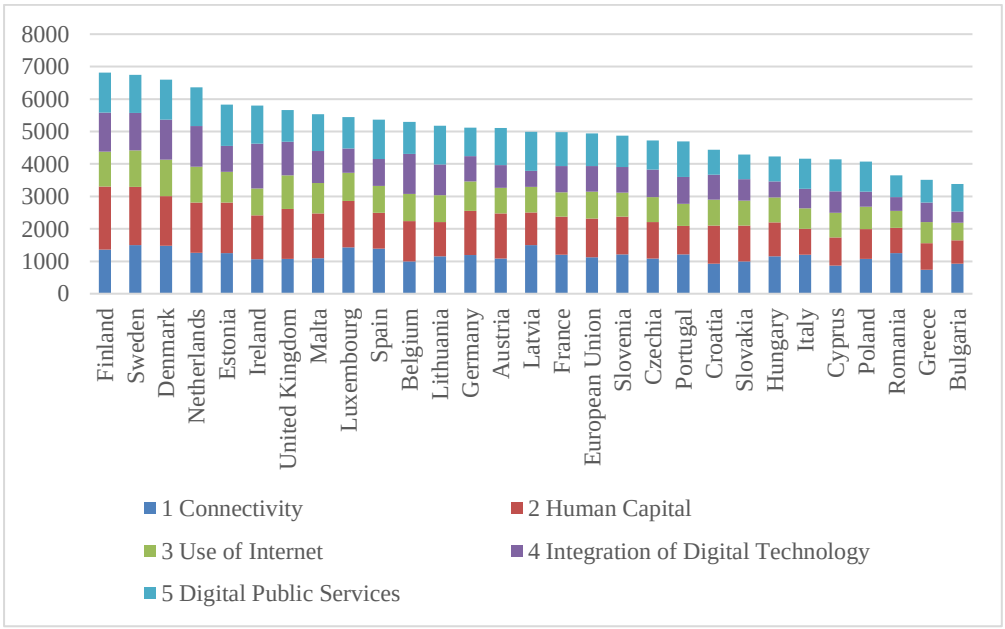
Denmark and Sweden, are the leading countries in terms of digitalization on the Europe continent, and the estimation of an impact of digitalization on unemployment has a high relevance for these countries.

The next section will be devoted to the literature review regarding the digitalization in the Nordic countries, followed by a methodology and data section, whereas the three sections after that will be present the empirical results and conclusions.

2. Literature review: Digitalization in the Nordic countries

According to a report of the European Commission (2019) about the Digital Economy and Society Index (DESI) (2019), the Nordic countries are the leading countries in terms of digitalization on the European continent (Figure 1). DESI index includes an analysis of connectivity (fixed broadband, mobile broadband, speed, and affordability), human capital (basic skills and usage, advanced skills and development), use of internet services (content, communication, and transactions), integration of digital technology (business digitization and ecommerce) and digital public services (eGovernment).

Figure 1 Digital Economy and Society Index (DESI), 2019



Source: own construction based on European Commission data (2019)

Of the Nordic countries, Finland is the leading country in terms of human capital, whereas Sweden is leading in terms of connectivity and use of the internet, and Denmark is leading in terms of digital public services and integration of digital technology. Iceland and Norway were not considered in this research.

Based on the European Commission report (2015), with the creation of the connected digital single market, countries can generate up to EUR 250 billion of additional growth in Europe and create hundreds of thousands of new jobs, notably for younger jobseekers. The digital single market can be achieved through the elimination of roaming charges, creation of the same data protection for companies regardless of their location, modernisation of copyright rules, and modernisation of consumer rules for online and digital purchases. The main goals of the EU eGovernment Action Plan 2016–2020 include the provision of the cross-border mobility of citizens and businesses, and support of the digital interaction between administrations and citizens in terms of the public services (European Commission 2016).

The report of Nordic Council of Ministers (2020) has examined qualitatively the impact of digitalization on employment and the structure of the labour market in the case of the Nordic countries. All the Nordic countries such as Denmark, Finland, Norway and Sweden were included in the report, only Iceland was not considered. According to the authors, during the past 20–30 years, the digital transformation has not led to reduced employment, slower job growth or increased labour productivity growth in the Nordic economies. The authors pointed out that despite no decrease in the employment, some jobs were affected by digitalization process. For example, new digital technologies have contributed to reduced employment growth and labour intensity in several industries such as retail, banking and manufacturing. In addition to that, the authors highlighted the importance of the service sector for the economies of Nordic countries. Nowadays employment in the service sector accounts for four-fifth of Nordic employment. According to the authors, the process of digitalization forced the rise of employment in the service sector for high-skilled employees, whereas in case of less-skilled employees the impact of digitalization is still uncertain. In terms of the structure of the labour market, there was a tendency towards an upgrading of the occupational structure of employment in most Nordic countries, except Denmark, in the period 2000–2015. This upgrade is characterised by the rise in employment with high pay and skill requirements and decrease in employment low-skilled and low-paid jobs. Authors also highlighted that the technological transformation brings further job decline in male-dominated manufacturing and other goods industries. According to the authors, the employment growth was somewhat stronger among women than among men, except in Sweden and Finland after the severe crises in the early 1990s. The authors also noticed that during the financial crisis of 2008, male employment was more sensitive to cyclical fluctuations, mirroring the male dominance in manufacturing and construction. The authors conclude that the role of economic cycles plays an important role in employment. The great ups and downs in Nordic employment since 1990 – as illustrated by Finland and Sweden in the early 1990s, and Denmark, Finland and Iceland after the 2008 crisis – are related to the impact of economic cycles, and financial crises in particular. According to the authors, it took almost a decade after the 2008 financial crisis before employment in Denmark reached pre-crisis levels, and around two decades in Sweden and Finland after their financial crunches in the early 1990s (Nordic Council of Ministers 2020).

These ideas were supported by data for unemployment (% of total labour force), taken from the World Bank official site (Figure 2).

In addition to the effect of economic cycles on employment, the authors highlighted the importance of immigration and aging society. For example, Denmark, Finland and Norway show quite similar employment rates in both 1990 and 2019, although the number of the employed increased much more in Norway because of its younger population and higher immigration. In Finland, ageing has brought decline in the labour force, and Denmark has seen stagnation. In case of Sweden, the economy has shown markedly stronger employment growth than Denmark, Norway and Finland since the 1990s, probably influenced by faster Swedish population growth, due to higher immigration (Nordic Council of Ministers 2020).

Based on the results, provided in the report of Nordic Council of Ministers (2020), it is possible to say that employment in the Nordic countries can be influenced not only by technologies, but also by economic cycles and demography. Despite the promising qualitative results, there is still no exact answer to how digitalization influences employment nowadays. There is also a need to prove or refute the current results of authors quantitatively. In this article I examine the impact of digitalization on unemployment quantitatively and compare the results with Nordic Council of Ministers (2020) report.

3. Methodology and data

The article assesses the impact of digitalization on unemployment in the case of the Nordic countries with the help of the robust OLS regressions in STATA. Because the process of digitalization was promoted through the increase in the internet connections in the late 1990s and was further developed by the high-speed internet and mobile data access, the chosen period for regression was 1991–2019 based on data availability.

The descriptive statistics of data is presented in Table 1.

Table 1 Descriptive statistics

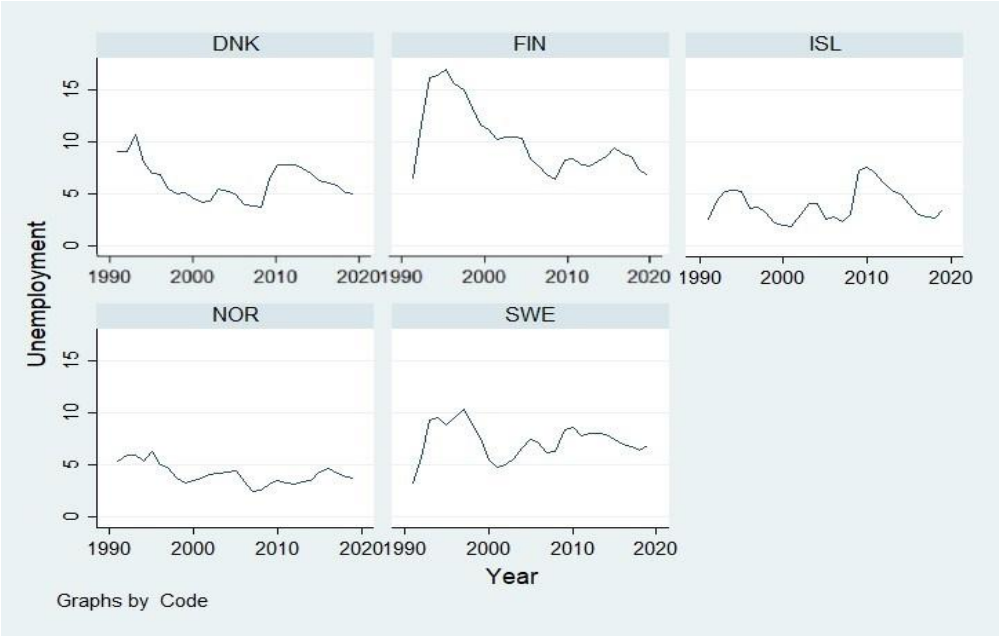
Variable	Obs	Mean	Std. Dev.	Min	Max
Year	145	2005	8.396	1991	2019
Internet	145	62.166	36.16	.194	99.5
Unemployment	145	6.327	3.021	1.87	17.01
Country	145	3	1.419	1	5
crisis2	145	.069	.254	0	1
crisis1	145	.103	.306	0	1

Source: own construction based on World Bank data

Because there were five countries considered in the period of 1991–2019, it is possible to say that the panel data were estimated.

As a dependent variable, I have used the yearly data of unemployment rate (% of total labour force). The data on unemployment were also taken from the World Bank official site (Figure 2).

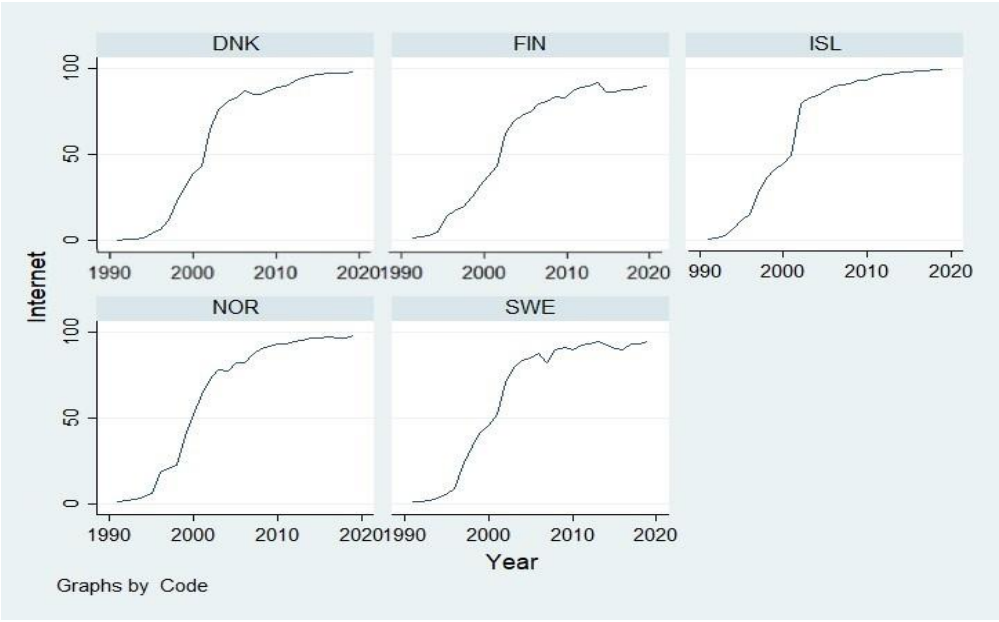
Figure 2 Unemployment, total (% of total labor force), 1991–2019



Source: own construction based on World Bank data

For the variable of digitalization I have used the yearly data of the variable from the World Bank official site – the Individuals using the Internet (% of population), (Figure 3).

Figure 3 Individuals using the Internet (% of population), 1991–2019



Source: own work based on World Bank data

As a result, the level-level regression model has been estimated. The first regression equation (1) has the following form:

$$\text{Unemployment} = \beta_1 \text{Internet} + \varepsilon \quad (1)$$

where ε is an error term. This regression equation will help to see if there is any impact of digitalization on unemployment on average in case of the five considered Nordic countries. But to be able to improve the model and consider each country separately, the final regression equation (2) for the robust OLS regressions has been created and has the following form:

$$\text{Unemployment} = \beta_1 \text{Country*Internet} + \beta_2 \text{Country*crisis1} + \beta_3 \text{Country*crisis2} + \varepsilon \quad (2)$$

In addition to dependent and explanatory variables two dummy variables of crisis were created and added into the regression equation. These variables were created for two crises: the crisis of 1990 and the global financial crisis of 2008. The dummy variable of crisis1 was created for the period of 1994–1996. The dummy variable of crisis2 was created for the period of 2009–2010. The periods were chosen based on the graphs in Figure 2. The use of these variables will help to improve the regression model because, as it was shown in the Nordic Council of Ministers (2020) report, the economic cycles are important determinants of employment in Nordic countries. To be able to examine an effect of digitalization on the unemployment rate for each country separately, an interaction between variables of the Internet and a variable of Country was created in the regression equation. To be able to examine the effect of the crises on the unemployment in each country, interaction between variables of crisis1, crisis2 and Country was created.

4. Results

Table 2 shows the results of the robust OLS regression based on equation (1) for the period of 1991–2019, for five Nordic countries, such as Iceland, Finland, Norway, Denmark and Sweden together. The dependent variable is the variable of unemployment rate, measured in percentage points, and the explanatory variable is the variable of individuals using the Internet, measured in percentage points too. To be able to see the effect of digitalization on the unemployment rate in each year separately, the regressions by year for the period of 1991–2019 were performed. The results are presented in Tables 4 through 10 in the Appendix, section 6.

Table 2 Linear regression, 1991–2019

Unemployment	Coef	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Internet	–.025	.007	–3.77	0	–.038	–.012	***
Constant	7.89	.479	16.48	0	6.943	8.836	***

Mean dependent var	6.327	SD dependent var	3.021
R-squared	0.091	Number of obs	145.000
F-test	14.239	Prob > F	0.000
Akaike crit. (AIC)	721.359	Bayesian crit. (BIC)	727.313

*** *p<.01,* ** *p<.05,* * *p<.1*

Source: own construction based on World Bank data

The results of the regression show that the variable of Internet has a high significance (*p*-value is less than 1%), which means that digitalization has an effect on the unemployment rate in the case of the Nordic countries, and on average has a negative association with unemployment. But it is possible to see that the R-squared is low, just 0.091, which means that the model could be improved.

To be able to improve the regression model, equation (2) has been applied. In addition to dependent and explanatory variables the dummy variables of crisis were created and added into the regression equation, which were created for the periods of 1994–1996 and 2009–2010. These variables will help to improve the regression model because the economic cycles can affect the unemployment rate. In addition to that, in the regression equation there were interactions between variables of Internet and Country and interaction between variables of crisis and Country. The results are shown in Table 3.

It is important to note that each country got its numerical equivalent for the regression, this information is important for the interpretation of the results. Iceland is number 1, Finland is 2, Norway is 3, Denmark is 4, and Sweden is 5.

Table 3 Linear regression with interactions and dummy variables of crisis, 1991–2019

Unemployment	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf	Interval]	Sig
1.Country*Internet	-.04	.009	-4.43	0	-.058	-.022	***
2.Country*Internet	.02	.009	2.10	.038	.001	.038	**
3.Country*Internet	-.041	.009	-4.75	0	-.058	-.024	***
4.Country*Internet	-.019	.009	-2.03	.045	-.037	0	**
5.Country*Internet	-.003	.009	-0.29	.77	-.02	.015	
1.Country*crisis1	-2	.751	-2.66	.009	-3.487	-.513	***
2.Country*crisis1	8.954	.731	12.25	0	7.508	10.4	***
3.Country*crisis1	-1.193	.689	-1.73	.086	-2.555	.17	*
4.Country*crisis1	.208	.747	0.28	.781	-1.27	1.686	
5.Country*crisis1	2.208	.69	3.20	.002	.843	3.573	***
1.Country*crisis2	3.993	.442	9.04	0	3.119	4.867	***
2.Country*crisis2	-.487	.41	-1.19	.237	-1.298	.324	
3.Country*crisis2	-.063	.281	-0.23	.822	-.62	.493	
4.Country*crisis2	1.592	.633	2.52	.013	.341	2.844	**
5.Country*crisis2	1.563	.266	5.89	0	1.038	2.089	***
Constant	7.151	.711	10.05	0	5.743	8.558	***

Mean dependent var	6.327	SD dependent var	3.021
R-squared	0.602	Number of obs	145.000
F-test	150.924	Prob > F	0.000
Akaike crit. (AIC)	629.478	Bayesian crit. (BIC)	677.106

*** *p<.01*, ** *p<.05*, * *p<.1*

Source: own construction based on World Bank data

The results of the regression show that for most of the Nordic countries, the variable of Internet is significant and mostly has a negative association with unemployment. Table 3 shows that in case of Iceland, in the period of 1991–2019, the process of digitalization led to a decrease in unemployment by 0.04% (*p*-value is less than 1%). There is a similar result in the case of Norway, the process of digitalization led to decrease in unemployment by 0.041% (*p*-value is less than 1%). In the case of Denmark the process of digitalization also decreased unemployment by 0.019% (*p*-value is less than 5%). The case of Finland has the opposite results: the process of digitalization led to an increase in unemployment by 0.02% (*p*-value is less than 5%). The case of Sweden shows that in the period of 1991–2019 the process of digitalization did not play a significant role for the unemployment (*p*-value is higher than 10%).

In addition to these results, it is possible to see that the economic cycles had a high significance for unemployment also for most of the countries. The crisis of the 1990s had a positive association with unemployment in the case of Finland and Sweden (*p*-value is less than 1%), which result is consistent with findings of the Nordic Council of Ministers (2020) report, according to which the employment of Finland and Sweden was affected by the crisis of 1990s.

In case of the impact of the global financial crisis of 2008 on unemployment, there was a high significance of the dummy variable of crisis2 for unemployment in the case of Denmark, Finland and Iceland, the regression shows the significance of the crisis for Iceland and Denmark and Sweden (*p*-value is 0, 0.013 and 0, respectively), whereas the impact of the global financial crisis on unemployment in Finland and Norway does not seem to be significant (*p*-value is 0.237 and 0.822 respectively) contrary to what was expected.

5. Conclusion

The topic of digitalization has a high relevance in the literature nowadays, where many authors try to figure out the impact of digitalization on the labour market in the short and long terms. Some authors argue that the process of digitalization creates new jobs, whereas other authors claim it increases unemployment. The Nordic countries, such as Iceland, Finland, Norway, Denmark and Sweden, are the leading countries in terms of digitalization on the European continent, and the estimation of an impact of digitalization on unemployment has a high relevance for these countries.

The paper assesses the impact of digitalization on the unemployment rate in the Nordic countries with help of the robust OLS regression in STATA, for the period of 1991–2019. Based on the results, it is possible to conclude that the process of digitalization already influences unemployment in most of the Nordic countries, whereas for some countries it does not have a significant impact nowadays, despite the high levels of digitalization. In addition to that, while considering the impact of digitalization on unemployment it is necessary to take into account the economic cycles as well. Results show that digitalization on average has a high significance and a negative association with the variable of unemployment. The increase of the variable of digitalization by 1% leads to a decrease in the unemployment rate by 0.025% in the case of the Nordic countries.

6. Appendix

Table 4 Linear regression, 1991–1994

VARIABLES	(1991) Unemployment	(1992) Unemployment	(1993) Unemployment	(1994) Unemployment
Internet	-1.218	-0.721	-1.003	-0.111
	(2.859)	(1.435)	(1.762)	(0.906)
Constant	6.498	8.399**	11.56***	9.403**
	(3.621)	(1.668)	(1.531)	(2.707)
Observations	5	5	5	5
R-squared	0.066	0.028	0.045	0.002

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own construction based on World Bank data

Table 5 Linear regression, 1995–1998

VARIABLES	(1995) Unemployment	(1996) Unemployment	(1997) Unemployment	(1998) Unemployment
Internet	0.654	0.0658	-0.0386	-0.0579
	(0.558)	(0.403)	(0.347)	(0.320)
Constant	3.591	7.269	8.620	8.427
	(3.187)	(3.345)	(7.513)	(9.685)
Observations	5	5	5	5
R-squared	0.350	0.006	0.002	0.008

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own construction based on World Bank data

Table 6 Linear regression, 1999–2002

VARIABLES	(1999) Unemployment	(2000) Unemployment	(2001) Unemployment	(2002) Unemployment
Internet	-0.352	-0.379	-0.158	-0.317
	(0.388)	(0.259)	(0.156)	(0.187)
Constant	19.03	21.88	12.88	27.50
	(15.02)	(12.12)	(8.977)	(14.03)
Observations	5	5	5	5
R-squared	0.236	0.395	0.184	0.533

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own construction based on World Bank data

Table 7 Linear regression, 2003–2006

VARIABLES	(2003) Unemployment	(2004) Unemployment	(2005) Unemployment	(2006) Unemployment
Internet	-0.474**	-0.369	-0.348*	-0.254
	(0.103)	(0.212)	(0.142)	(0.252)
Constant	42.51**	35.58	34.14*	26.60
	(7.926)	(17.11)	(10.92)	(21.48)
Observations	5	5	5	5
R-squared	0.848	0.476	0.481	0.207

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own construction based on World Bank data

Table 8 Linear regression, 2007–2010

VARIABLES	(2007) Unemployment	(2008) Unemployment	(2009) Unemployment	(2010) Unemployment
Internet	-0.507**	-0.250	-0.198	-0.470
	(0.0997)	(0.227)	(0.191)	(0.334)
Constant	47.41**	26.36	24.32	49.68
	(8.294)	(19.85)	(16.11)	(29.55)
Observations	5	5	5	5
R-squared	0.897	0.222	0.163	0.421

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own construction based on World Bank data

Table 9 Linear regression, 2011–2014

VARIABLES	(2011) Unemployment	(2012) Unemployment	(2013) Unemployment	(2014) Unemployment
Internet	-0.353	-0.504	-0.628**	-0.368**
	(0.303)	(0.288)	(0.162)	(0.101)
Constant	39.15	53.46	65.88**	40.93**
	(26.98)	(26.32)	(14.56)	(9.083)
Observations	5	5	5	5
R-squared	0.208	0.345	0.318	0.616

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own construction based on World Bank data

Table 10 Linear regression, 2015-2019

VARIABLES	(2015) Unemployment	(2016) Unemployment	(2017) Unemployment	(2018) Unemployment	(2019) Unemployment
Internet	-0.429***	-0.408**	-0.472**	-0.430**	-0.336**
	(0.0519)	(0.0990)	(0.104)	(0.0895)	(0.0967)
Constant	46.46***	44.24**	50.20**	45.94**	37.40**
	(4.521)	(9.022)	(9.361)	(8.312)	(9.374)
Observations	5	5	5	5	5
R-squared	0.908	0.812	0.814	0.826	0.714

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own construction based on World Bank data

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Transoceanic trade triangle of the US–EU–China: A game theoretical analysis on its present and future relations

Eszter Kovács

As part of global trade, the emergence of free trade agreements has resulted in the removal of tariff and non-tariff barriers over the past seventy years. The major trade actors (European Union, United States, and China) have become economic rivals, which make them compete in confrontational or cooperative ways for greater benefits and welfare. This paper discusses three free trade agreements between the US–EU–China: the Transatlantic Trade and Investment Partnership (TTIP), EU-China Comprehensive Agreement on Investment (CAI), and the Economic And Trade Agreement Between The Government Of The United States Of America And The Government Of The People's Republic Of China (ETA). The author's contribution is the creation of alternative scenarios to analyse the effects of these treaties on profit from a game theoretical approach. The results of this model suggest that cooperation generates greater economic benefits in each situation compared to competitive strategy. At the same time, players' welfare cannot be identified with profit in all cases.

Keywords: free trade agreements, international relations, trade policy

1. Introduction

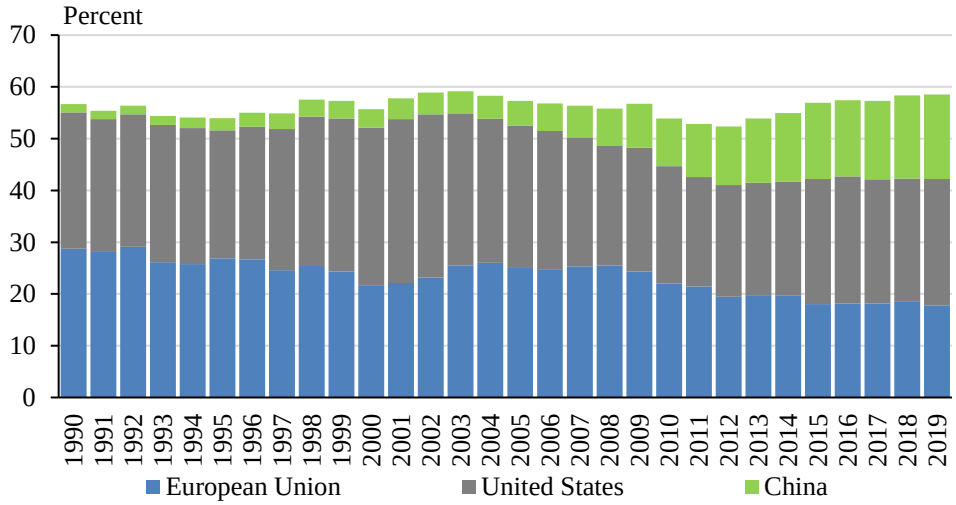
Free trade agreements are treaties between two or more economies aimed at the reduction or elimination of tariff and non-tariff barriers. Despite the fact that they are important creators of international trade, partly due to the lack of information, the literature barely deals with their practical operation and methodology. These are explained almost exclusively by WTO manuals. Data on the subject are mainly provided by the WTO, World Bank, ITC, OECD and UNCTAD databases. However, a comprehensive study of their content, characteristic features, and structure already appears in various analyses (Kutasi 2015, Acharya 2016).

The European Union, the United States, and China have become the world's most important trading centers in recent decades. This has also contributed to the negotiation of deeper, more comprehensive trade agreements between these economies. Among the collaborations, the *EU–China CAI* (EU-China Comprehensive Agreement on Investment) has already been signed. However, the agreement is currently suspended, and the *TTIP* (Transatlantic Trade and Investment Partnership) and the *US–China ETA* (Economic and Trade Agreement Between The Government Of The United States Of America And The Government Of The People's Republic Of China) are also suspended or blocked. At the beginning of the negotiations, the primary objective was the abolition of tariffs, but removing barriers in many fields was also aimed at. Despite opening up to each other, a number of tariff sanctions are currently applied against each other in some economic areas in the form of customs war. Harmonization of rights and norms differs in the three continents, which also makes it difficult to conclude

agreements. At the same time, there are strong motivations behind the initiatives: economic expansion, geopolitical power, geostrategic preferences, etc. Although the world is currently described as a multipolar center of power in foreign policy studies, the EU can only play a secondary role in this due to its disintegrated political system and significant internal economic disparities. Moreover, for the future, a US–China bipolar world order is clearly projected for the second third of the 21st century. In this geostrategic situation, the US is, for the time being, the main ally of the EU, which is why the EU is necessarily interested in closer cooperation, at least through conventions (Kutasi 2015).

The United States has the largest share in world GDP, accounting for 25 percent of total output, while the European Union and China account for 18 and 16 percent of total production[1] (Figure 1), respectively. In this context, the study provides a comparative analysis of the agreements listed above. The contributions are the comparison of political areas identified in these negotiations, and the description of possible outcomes on the export surplus of the United States, the European Union, and China.

Figure 1 Share of large economies in world GDP



Note: nominal data
Source: author's elaboration based on World Bank (2021)

The EU and the US depend on China in several goods and services, but the dependency is mutual. China seeks the high technologies to become self-sufficient. By overcoming obstacles, cooperation between these economies shall promote a higher level of economic growth.

Many studies deal with the effects of these agreements, but fewer examine the potential choices available for players and the consequences of their choices when they are committed to conclude a treaty. In this study, I introduce the strategic options and interpret them from a game theoretical perspective.

[1] Based on nominal data in 2019.

The main question is whether cooperation or competition brings greater benefit for players. The results in the examined cases show that cooperation yields higher profit compared to competition, and a relatively higher profit can be achieved with cooperative strategy. Although, I based this on the status of the conventions, I conclude that geostrategic or geopolitical interests are stronger than economic profit for the players.

The remainder of this paper is organized as follows. Section 2 gives a short summary of the three agreements. Section 3 introduces the related literature. Section 4 sets up the methodology. Section 5 presents the results. Finally, Section 6 concludes with a summary.

2. Transoceanic Trade Triangle Review

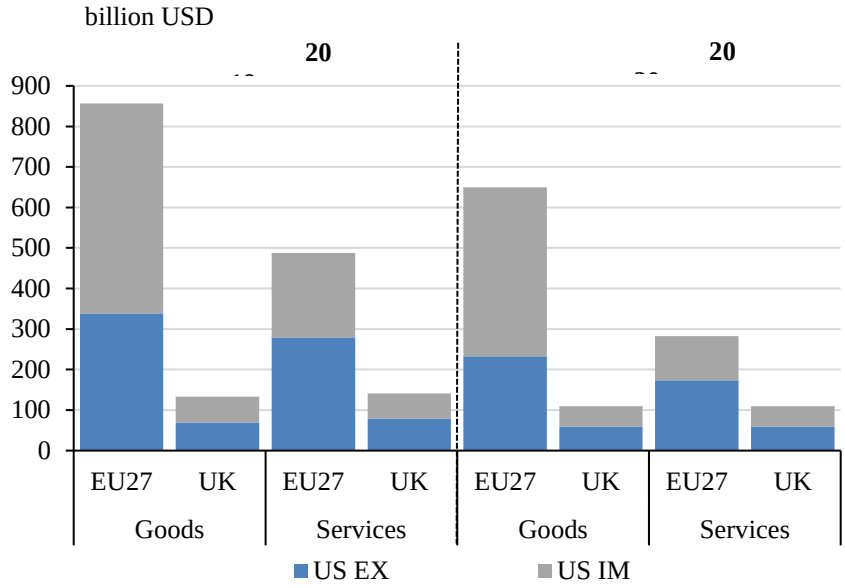
The transition from original free trade agreements to modern cooperation forms dates back to the 1990s. In the 2010s, however, trade negotiations reached another milestone. Evolution of deep and comprehensive trade agreements began, aiming not only at trade and investment potential, but also at a global harmonization of regulations (Kutasi et al. 2014),

2.1. EU–US Transatlantic Trade and Investment Partnership (TTIP)

TTTP (negotiated since July 2013) would have been one of the largest bilateral free trade agreements, covering around 30 percent of world trade and 50 percent of global output, once fully ratified by the two participants. President Trump expressed his willingness to reopen negotiations on the EU–US agreement in 2018, and the current Biden administration has not ruled it out, but so far no progress has been made on concluding the agreement. However, the treaty has been cast off, and the most recent research sees a great chance to renew the agreement, highlighting the linkage between trade policy and climate protection as a great opportunity for transatlantic trade relations. Successful cooperation in this area could be the value of international collaboration, tangible and thus spilling over into other economic and financial policy areas (such as rules for digital technologies, protection of data access, a sustainable finance architecture with standards for a green financial market, and fair taxation in the digital age, etc.) (AICGS 2021, Wilson Center 2021, WPR, 2021).

By bringing these economies together, the parties expect deeper cooperation and economic benefits. Once the negotiation process is completed and the agreement comes into force, it will strongly shape future global trends and foreign direct investments. The gains come from lower commodity prices, greater product variety, technology transfer, and higher productivity (Felbermayr et al. 2013). The European Union was the United States' largest trading partner in 2019, giving around one-fifth of total US trade. However, Brexit and the Covid-19 pandemic have altered the EU–US trade volume in 2020 compared to 2019 (Figure 2).

Figure 2 EU–US Trade volume



Note: seasonally adjusted data
Source: author's elaboration based on the US Bureau of Economic Analysis (2021)

Regulatory changes may lead to additional tariffs levied on goods traded in some sectors (between 10 and 20 percent), compared to classical negotiations where the average tariff level is only 4 percent. The additional growth effects would mean GDP growth of around 0.5 percent for the European Union's economy and 0.4 percent for the United States. This shows that the significance of TTIP relates more to the removal of non-tariff barriers (legislation, standards, licences, etc.) to economic benefits, and perhaps goes beyond these. This is now the biggest obstacle for activist groups and businesses who stand to lose in this process (CEPR 2013).

The other impact is related to trade diversion, and this may be created by the European Union itself. Given the lack of internal trade barriers within the integration, a significant intra-EU trade takes place within the region's borders. If the US removes tariff and non-tariff barriers, some EU trade likely to be diverted to the US. The explanation would be as following. Initially, EU countries trade with each other, but if a member state starts importing from the US, it reduces intra-EU trade, so trade creation becomes destructive for the EU. In addition, if the difference between the pre- and post-trade volumes is relatively large, the US will not be able to compensate the member states for the effects caused by trade diversion (Felbermayr et al. 2013).

The two parties waged a tariff war during the period 2017–2019. Under the Trump administration, the US began to impose protective tariffs on steel and aluminium export products from the EU in 2017. As a result, the EU announced its intention to impose countervailing tariffs to the full list of US products submitted to the WTO to reimburse the amount lost. From 2019, the US (due to prohibited subsidies) has applied additional tariffs, among other things, to aircraft parts and automotive products, which it has amended several times since then. In 2020, the EU levied digital taxes on several

large US technology firms. In response, the US envisaged raising car import tariffs. The most favoured nation (MFN) principle has been already applied to various product groups, but the parties are currently imposing high tariffs on each other's goods and services with the highest revenue (European Parliament 2015).

2.2. EU-China Comprehensive Agreement on Investment (CAI)

On 30 December 2020, the EU and China concluded the Comprehensive Agreement on Investment (CAI). By the cooperation, EU investors will get greater access to China's market. According to the agreement, China ensures fairer treatment for EU companies, which means that they can compete on a wide playing field in China.

The two states agreed on such policy areas as state-owned enterprises, transparency of subsidies, rules against forced technology transfer, sustainable development, including commitments on climate and forced labour, investment protection and investment dispute settlement. The agreement also allows foreign direct investment in production and manufacturing in China in case of a number of industries that were not or only to a limited extent possible at the time. In 2019, Chinese FDI in the EU was higher than the EU investment in China, especially in the field of transport, utilities and infrastructure (Figure 3).

Restrictions have been subsisted in only a few industries where China has a significant overcapacity. After the entry into force of the CAI, EU investors will not be required to disclose their technological secrets to their Chinese joint venture partners. The handling of technological and business information brought to the attention of the Chinese authorities during licensing procedures will be strictly regulated by the pact (European Commission 2021b).

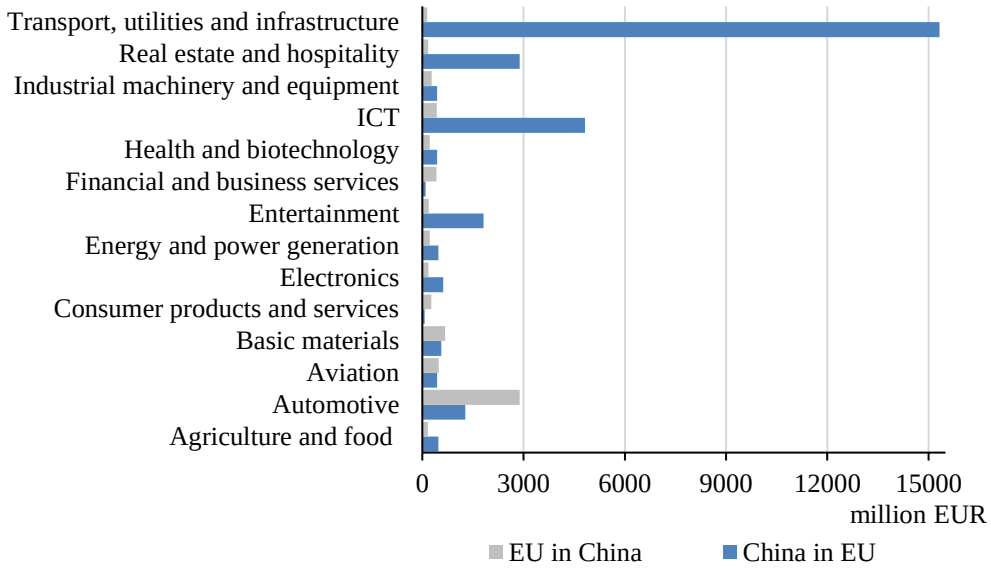
Various activists, NGOs and major economies (including the US) have also expressed concerns about the convention. Relevant economic issues that are common in debates are as follows:

- Norms and rules differ between the two economies in many fields. China follows a much more liberal principle, so the agreement could be a tool to bring the country closer to certain democratic and human rights norms and rules.
- The European Commission (2021b) has only recorded the fact of the agreement, the elaboration or entering into force of several policy areas is still unclear.
- It is expected that China will implement the International Labor Organisation's (ILO) provisions concerning prohibition of slavery, forced labour.
- Most European companies are distrustful of technology sharing. This is evidenced by the fact that, according to preliminary surveys, the willingness to invest in setting up EU–China joint ventures is low.

At the same time, according to the Commission, China has also made serious commitments in three important areas, namely, market access, ensuring equal competition, and sustainable development.

Overall, it may be that mutual investments start under the new conditions. The pact is expected to reach the final signing stage in 2022, pending several issues and conditions to be clarified between the parties.

Figure 3 Cash flow and capital stock of FDI in 2019, by sector



Note: nominal data
Source: author's elaboration based on Rhodium Group (2021)

2.3. Economic and Trade Agreement between the United States of America and China (ETA)

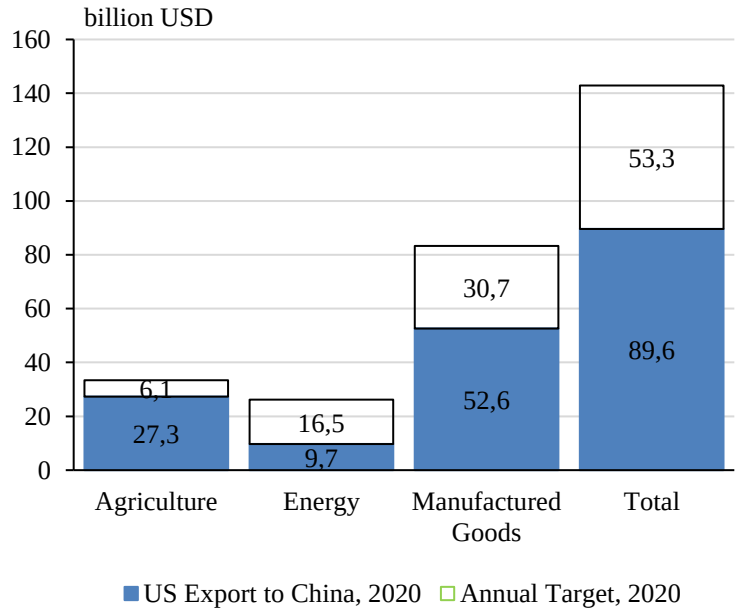
The United States and China signed the Economic and Trade Agreement on 15 January 2020. The pact aims to open Chinese markets to more American companies, enhancing agricultural and energy exports, and ensuring a higher level of protection for American technology, trade secrets, patterns, and rights. China has committed to purchasing an additional 285.8 billion USD worth of American goods and services by 2021 and is expected to eliminate or moderate several tariffs on American products. China's purchases in 2020 (first year since the agreement) were below its commitment levels in all sectors (Figure 4). US exports to China in 2020 were below the target, mainly because of the imposed retaliatory tariffs by China in response to President Trump. Partly, that is why the agreement preserves the tariffs placed by the Trump Administration (360 billion USD worth on Chinese goods) and maintains additional tariffs if Beijing does not meet the terms of the agreement in order to address overcapacity in China (NYT, 2021).

The ETA provides a variety of positive effects from the opening up of markets for pharmaceutical and energy industries, beef and poultry, biotechnology, banks and insurers. China has promised not to acquire sensitive technology through acquisitions. Both parties agree that they are not to devaluate their currencies to gain advantages in export markets.

Beside economic benefits, critics highlight that negative economic, geopolitical and social factors are surrounding the ETA:

- The treaty does not deal with cybersecurity (relating companies' handling data, cloud computing, China rejected demands that refrain from hacking American companies);
- Crucial industries like solar energy and steel in the United States are threatened by the cheap Chinese goods. American companies blame political decision-making for not solving this economic practice with the treaty (USTR 2021).

Figure 4 Trade commitments in phase I



Note: nominal data
Source: author's elaboration based on the US Census Bureau (2021)

3. Literature review

This section addresses key literature that deals with the impact assessment of international trade agreements. Cost-benefit theories have appeared several times in relation to states. Integration theories draw attention to trade creation and trade diversion (Palánkai 2011). In the economics of international organizations, states can establish collaborations as profit-maximizing individuals (Blahó 2004). Fratianni and Pattison (1982) and the functional approaches underline the marginal benefits and marginal costs of these agreements. Market theory analyses cartels and identifies their welfare-increasing, welfare-reducing effects at a national economic level. The realist school sees countries as individual competitors, which is a microeconomic approach, as states seek to maximize welfare in the international system.

3.1. The impact assessment of free trade agreements

Since the 1970s–80s, a comprehensive integration process has taken place in the world economy, encompassing micro- and macro-processes. That means that the corporate, national, regional and global integration processes in the international trading system happen in parallel and are intertwined (Blahó 2004).

The literature generally distinguishes between the regional economic integration levels according to the typology by Balassa (1961). In the case of a free trade area, tariffs and quotas within the zone are abolished, but customs duties and quotas are applied to outsiders (EFTA, AFTA, NAFTA). The customs union does not apply customs duties and quotas within the zone but defines a common external customs duty and foreign trade policy vis-à-vis the outsiders (EU–Turkey Customs Union). The common market liberalizes not only goods and services in the customs union but also the flow of capital and labour (MERCOSUR). In addition to the abolition of customs barriers, the single market includes the removal of non-tariff barriers (EC) (Palánkai 2011). The economic and monetary union also accomplishes the unification and coordination of economic and monetary policies (EMU). Political union means raising power and legislation to a supranational level where a "supranational authority" can make decisions.

With the appreciation of regional economic integrations, there has been an increasing emphasis on assessing the benefits and costs they bring. Customs union theories are the first to analyze the links between free trade and the international division of labour. Within this framework, Viner (1950) considers trade creation to be a positive effect of the customs union, and even trade diversion to be a negative outcome of the customs union. Meade (1955) already highlights the impacts of production and consumption. As a result of cheaper imports, savings become higher, which increases consumption. He calls such an increase in imports trade expansion, and a change in the opposite direction trade contraction. The transportation costs of trade are identified by Samuelson (1952) in the iceberg trade cost metaphor that means some of the profits melt as the geographical distance increases.

3.2. Applying game theory to international relations

Game theory as a potential methodological tool is commonly used in international trade to illustrate different situations. From the 1950s onwards, the situations observed in the international system began to be examined with game theory models. In addition to individuals, analyses also focus on the global level with states and nations. However, theories already differ in determining the benefits of interactions among economic players. The realist school (Morgenthau 1951, Kiss 2003, Szörényi 2009) rejects the interaction between states, which is justified by zero-sum games. The neorealist conception is already more lenient if there is a hegemonic power modeled by the prisoner dilemma. In this game, the parties are better off cheating because they can reap greater benefits. The neoliberal school emphasizes the importance of cooperation, modeled by the repeated prisoner dilemma. The game demonstrates the states' ability to cooperate in the long run (Keohane 2005).

Inter-state relations are most often illustrated in a game theoretical approach by the two-player prisoner's dilemma (conventional game). This describes the different trade policy perspectives of nations. In the game, cooperative behavior (concluding a trade agreement) would be more beneficial than if the parties did not collaborate. The outcome of the game, however, is that they both refuse cooperation because their individual interest is thus higher. This concept can also be applied to trade relations between states. There are cases where, although the parties previously promised to cooperate, in the end they do not conclude a trade agreement because their personal interest (maximization) overrides the agreement (Krugman 1991, Bagwell and Staiger 1999, 2002).

The prisoner's dilemma can be a one-shot game or a repeated game with the Nash-equilibrium (Keohane 1986, Krugman 1992, Axelrod 1997). Players' decision options are illustrated by the payoff matrix, which are sets of players' strategies in the same game. When determining the matrix, we assume that players prefer higher profits over fewer, and they are also affected by non-financial incentives in some cases (Kreps 2005). However, as game theory evolves, more and more complex methods are emerging for examining trade relations.

In the 2000s, evolutionary games appeared for purposes of analyzing trade cooperation. These games included a larger number of players, became less static, and do not rely on the rational behavior assumption against conventional game theory models (Gintis 2009). In this game type, the successful and inefficient strategies of nations are illustrated by numerous authors such as Elkins and Simmons (2005), Gintis (2009), Gilardi (2010), and Yukawa et al. (2014).

This paper proposes a two-player model in a conventional game rather than an evolutionary game to reduce the complexity of the structural models.

4. Methodology

Modeling trade relations necessarily consists of two different parts: a game that is played by all participants of a trade agreement, and the evaluation of results with the payoff matrix. To explore the opportunities that lie among the three chosen actors (US, EU, and China), it is necessary to view the interactions between them in the examined period.

TTIP, CAI, and ETA are actual cooperative approaches, but of these, there is still no agreement in force that has been taken by the economies. Therefore, research is focused on the export revenues and strategic decisions. Data has been collected for 2020, covering the annual export good revenues of each economy in order to obtain accurate results. This paper categorizes the interaction types as three scenarios:

Scenario 1: trade wars without agreements

Scenario 2: no trade wars with agreements

Scenario 3: no trade wars, agreements without tariffs

The results are inserted into a payoff matrix for comparison; thus, we are able to determine the winner situation of participants. However, we do not rule out the possibility of achieving different results by other methods.

4.1. Game theory

Game theory as a methodology describes situations of conflict and cooperation. A game necessarily consists of three elements: players, strategies, and payoffs.

Players are rational decision makers. *Rational players possessed a payoff function π in any decision-making situation (.) over strategies is rational if they choose a strategy $a \in A$ that maximizes their payoffs. That is, $a^* \in A$ is chosen if and only if $\pi(a^*) \geq \pi(a)$ for all $a \in A$* (Neumann and Morgenstern, 1944).

Players make their choices based on optimization according to utility maximization problem. In the game, each player, when deciding what steps to take, must consider how others may respond to that action. Although the literature generally agrees that trade policies are aimed at maximizing economic profit, we often encounter situations where economic benefits are pushed into the background and replaced by other geopolitical or security policy interests (Laidi 2008, Dieter 2014, Kutasi 2015, Eichengreen et al. 2019).

The consequences of their choices are represented as a payoff matrix, which shows all the possible combination of outcomes according to the strategy chosen by players. Each player is assumed to know their own mind and to be able to identify the payoff of each strategy they choose (Mankiw and Taylor 2017).

The model framework that will be used for illustrating cooperative and competitive strategies between the United States, the European Union, and China in this paper can be described as a normal-form game. *An n-player game in normal form, $n \geq 2$, is a set [n] of players and a finite set of strategies S_i for each player i. We denote the set of all strategy profiles of players other than i by S_{-i}. Finally, for each $i \leq n$ and $s \in S$ we have an integer payoff or utility u_s^i* (Daskalakis and Papadimitriou, 2005:2).

4.2. Model development

To construct a payoff matrix, we obtain the export revenue functions for each player according to the three scenarios.

Scenario 1: trade wars without agreements

$$\pi_i^{EX}=\left(p_i^{EX}-c_i^{EX}\right)*q_i^{EX} \text{ where } c_i^{EX}=t_i^{EX} \quad (1)$$

Scenario 2: no trade wars with agreements

$$\pi_i^{EX}=\left(p_i^{EX}-c_i^{EX}\right)*q_i^{EX} \text{ where } t_i^{EX}>0 \quad (2)$$

Scenario 3: no trade wars, agreements without tariffs

$$\pi_i^{EX}=\left(p_i^{EX}-c_i^{EX}\right)*q_i^{EX} \text{ where } t_i^{EX}=0 \quad (3)$$

Table 1 Notations

i	index (i = US, EU, China)
p_i^{EX}	export price of country i
q_i^{EX}	export quantity of country i
c_i^{EX}	export cost of country i
t_i	tariff rate paid by country i
π_i^{EX}	export profit of country i
∂	annual growth of export revenue
n	number of players
A	possible variable

After determining the payoff matrix, we obtain the minimum criteria for the economies to conclude an agreement in the context of rationality. For this, we are able to apply the superadditive function:

$$\pi\left(\bigcup_{i=1}^{n} A_i\right) \geq \sum_{i=1}^{n} \pi(A_i) \tag{4}$$

$$\text{Since, } \pi(US, EU, China) \geq \pi(US) + \pi(EU) + \pi(China), where \tag{5}$$

$$\pi(US, EU, China) = \sum_{i=1}^{3} \pi_i^{C,t=1} = 890.7 \cdot \partial, and \tag{6}$$

$$\pi(US) + \pi(EU) + \pi(China) = \sum_{i=1}^{3} \pi_i^{\bar{C},t=1} = 890.7 \cdot \partial \geq 754.4 \tag{7}$$

$$\partial = 1.1807$$

Considering the characteristic function of superadditive, at the point, where $\partial = 1.1807$, players decide about cooperation or competition. Less growth than this value will certainly lead to competition according to the set function.

5. Results

The profits are obtained for the United States, the European Union and China according to the scenarios in a payoff matrix.

5.1. Payoffs of alternative scenarios

The economies' export performance heavily depends on the tariffs imposed on goods. In this chapter, the study elaborates three alternative scenarios that examine how much revenue the parties could have expected if trade wars had ended, and tariffs had been eliminated.

To investigate the unexplored cooperation possibility between the European Union, the United States, and China, it is necessary to view all opportunity that may

arise from the current situation. There is still no comparative analysis that examines the elaborated cases, therefore I collected data for empirical evidence. My intention with the study has been to explore the best option of the three largest economic players. This study lists the competition and cooperation policies as three scenarios (first, when the parties wage a trade war without any agreements; second, when trade wars are taking place with agreements, which means that players increase tariffs in areas not covered by the trade agreement; third, when no trade wars happen and the economies conclude agreements; and finally, no trade wars, agreements are in effect, and trade occurs without tariffs). The data has been collected for the EU, US, and China for 2020 (USCB 2021). The final results are summarized in Table 2 for comparison and discussion.

Table 2 Payoff matrix

Scenarios	EU	US	China	Total
	Million USD			
Scenario 1 *trade wars without agreements*	611.5	314.2	800.1	1,114.3
Scenario 2 *no trade wars with agreements*	674.2	431.7	874.2	1,980.1
Scenario 3 *no trade wars, agreements without zero tariffs*	710.2	453.2	900.1	**2,063.5**

Note: In case of the EU, export good revenues contain the EU good export revenues to US and China. In case of US, export good revenues contain the US good export revenues to EU and China. In case of China, export good revenues contain the China good export revenues to EU and US.
Based on actual export in 2020.
In scenarios 3 and 4, revenues are adjusted by tariffs.
Source: author's calculation based on US Census Bureau (2021)

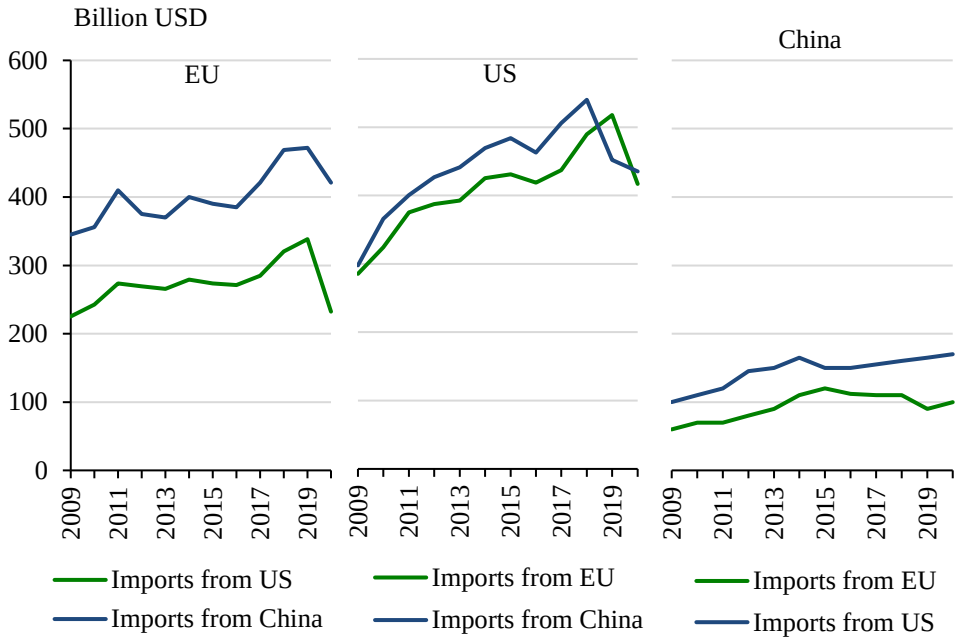
The difficulty of choices lies in determining the extent of interaction between participants. Competition results in a separate enforcement. Collusion is a kind of willingness to move in the other direction. Cooperation is adherence to the rules that result from commitment. Integration is a deepened form of commitment, where economic policies and norms are harmonized. Coordination results in the greatest dependence through joint, supranational governance (Blahó et al. 2004, Benczes 2014). The payments to the actors depend on the choice of strategies, i.e. the expected profits vary.

Our estimations support that in the cases in which cooperative strategy is applied, the revenues are higher compared to competitive situations. Microeconomics highlights the individual rationality (Mas-Colell et al. 1995), but the best decision for one player may not be necessarily the best option to the others, or for all the players. In our case, results suggest that both the individual and the group revenues are the highest when no trade wars occur and the tariff levels are eliminated between the actors.

All three economies are located in different continents, which strengthens their role in the world economy. From a geopolitical perspective, the EU and US are strongly dependent on Chinese import goods. This level of import exposure is no longer substitutable for other products. Although China is able to retain its leading export position, the market share may decline with the appearance of new technologies.

Finally, the country is forced to adapt new technologies and to access infrastructural development that preserves its competitive advantage. Thus, the rational behaviour is for the three big trade players to cooperate with each other and form treaties (Figure 5).

Figure 5 Trade triangle between the EU–US–China



Note: The US–China trade war has begun in 2018
Source: author's elaboration based on US Census Bureau (2021)

6. Conclusion

This study has provided an exploratory analysis of the three economies' trade trends and analyzed both competitive and cooperative strategies among the US, EU, and China using a game theoretic model.

The main question has been whether the parties should cooperate with each other, or whether they should just compete if they are committed to improving their current situation. However, the presented treaties are doubtful, and the parties have taken cooperative initiatives that allow us to analyze their behavior.

The base objective of free trade agreements is that they are concluded for the purpose of reciprocal reduction or elimination of tariffs (cooperative competition). This statement is in line with our findings. First, in the game, all the players seek to maximize their profits, and since cooperation ensures the most beneficial outcome, they are committed to concluding the agreements (the rational decision of players). At the same time, many factors (conflicting interests in the field of environment, laws, etc.) were introduced that have a strong impact on the success of the mentioned treaties. In comparison, parties seem to be more open towards forming such provisions in

agreements that elaborate on common dialogue and eliminate differences from each area. Taking into account only the scope of the treaties, these disparities seem to be even more significant. On the other hand, the majority of the provisions concerns non-economic areas, so benefits link mainly to geopolitical and social issues (geopolitical power and geostrategic role). The actors in the agreements make their strategic decision in the light of these, which could provide explanations for the current status of the TTIP, ETA, and CAI. It is highlighted that these findings may not be generalizable.

By creating a trading model, I have aimed to get closer to understanding reality and to show situations in which the exploitation of trading tools can be useful. For further research, a more sophisticated and complex model could be taken into account with data that covers expenditures and size of the economies. In addition, future research can be extended to include some environmental, political, or other economic variables.

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Auctions as a measure in meeting renewable energy targets: Selected cases from developing countries

Shahi Md. Tanvir Alam

With the determination to achieve 100% carbon free energy generation by 2050, renewable energy has been widely accepted as a feasible option for environmentally friendly and inclusive economic growth. Giving priority to this support mechanism is vital to upholding a steady and conducive atmosphere for investment in this sector while meeting the anticipated target in the energy system in an economical way, and policy makers reveal that auctions have reached their pinnacle in due course of time. Merely 29 states had applied renewable energy auctions up to the end of 2017 and their number increased to 41 in 2019. The present study aims to prepare a roadmap for achieving the carbon free green energy production target within the stipulated period while meeting future energy demand through a cost-effective auctioning scheme. The research outlines the feasibility of suggested auctioning schemes, highlighting some country-specific empirical evidence and potential benefits for countries. For this, qualitative research has been conducted to summarize and assess the necessary conditions to develop an auctioning model. The results indicate that for the emerging economics that are provided with renewable energy sources, technology-neutral site-specific volume auctions systematically scheduled, together with socio-economic development instruments under qualification requirement, result in diversified gains.

Keywords: renewable energy, auction scheme, cost-effectiveness, socio-economic development, diversified gains

1. Introduction

The adverse effects of environmental degradation are now of concern in all walks of life and in the mean-time, entire nations - irrespective of developed or developing - have started making diverse and extensive efforts to adopt new measures to mitigate the effects. For the socio-economic upliftment of developing countries, the importance of availing themselves to sustainable and environmentally responsible sources of energy has been engrained as a precondition. Fossil fuels have for long been burnt in earlier eras to generate electricity, and are responsible for the emission of huge amounts of carbon dioxide (CO_2) into the air. Thus, the majority of the world's leading policy makers are determined to reach 100% carbon free energy generation by 2050. Highlighting this determination, the extensive deployment and utilization of renewable energy (RE) has gained high priority in the related policies on sustainability and climate change in the global arena.

Apprehension in the world community to the spectacle of detrimental climate change (i.e., global warming due to carbon emission) has led to investment in/support research in RE with affordable, economical, and technologically developed means. According to the Sustainable Development Goal (SDG) 7, it is urged that "Clean Energy for everyone"- secure access to affordable, reliable, sustainable, and modern energy for

everyone. To make RE affordable and economical, the cost must be competitive and not put further burden especially on developing countries. If RE prices become competitive, RE will become affordable to wider society. To this end, current practices are showing that an auction scheme for renewable energy sources (RES) can be a fruitful medium for delivering affordable energy in both developed and developing countries.

Bangladesh has achieved steady economic growth for the last decade. Very recently (27 February 2021), Bangladesh received the second recommendation from World Bank to be removed from the list of least developed countries (LDC) and step up into the list of developing countries. As per the projection of Japan International Cooperative Agency (JICA), the gross domestic product (GDP) per capita (nominal) for Bangladesh is expected to reach 10,993 US$ in 2041 and Bangladesh has set the goal of being a developed nation by 2041 (source: PSMP 2016). Further, PSMP (2016) says, by 2041 Bangladesh's power generation target will be 60,000 MW, of which 10%, i.e., 6,000 MW will be from RES.

In keeping industrial production steady, electricity plays a crucial role. Most electricity in Bangladesh is produced by gas (57.36%), alongside 25.16% by furnish oil (HFO), and 7.23% by high-speed diesel (HSD) (source: Power Cell, Bangladesh on June 2020). But due to the gradual declination of indigenous gas reserves and the limitation in new gas wells, Bangladesh is also importing liquefied natural gas (LNG). Recent analysis shows that the energy import cost for Bangladesh will be 20,000 million US$ in 2030. But the country has the potential to acquire electricity from solar (mostly) and wind. According to National Renewable Energy Laboratory (NREL), the country experiences wind speed of 5.75–7.75 ms^{-1} and there are more than 20,000 m^2 of land with a gross wind potential of over 30,000 megawatts (MW). NREL also says that Bangladesh receives moderate level solar radiation on a daily basis (GHI≈ 4.5 kWh/m^2) which can be converted into reasonable sources of energy via either a thermal or PV route. By 2020, the electricity production from RE was 650 MW (source: Power Cell, Bangladesh), which was far beyond the expected level.

Aligning itself with the world's carbon reduction target, Bangladesh ratified the Paris Agreement on 21 September 2016. On 25 September 2015, it submitted Intended Nationally Determined Contributions (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) with an ambitious Green House Gas (GHG) reduction target of 15%, i.e., 36 $MtCO_2$ conditional and 5%, i.e., 12 $MtCO_2$ unconditional from Business as Usual (BAU) by 2030 (source: INDC 2020). But in reality, the CO_2 emissions trend from fuel combustion in Bangladesh is upward – in 2014 it was 63.10 $MtCO_2$ and 82.00 $MtCO_2$ in 2018 (source: IEA world Atlas 2018).

Recently, Bangladesh drafted its 'National Solar Energy Roadmap 2021-2041' for achieving its RE target by 2041 considering 03 scenarios-BAU, medium case & high case and based on these scenarios the potentiality of GHG emission reduction has been calculated as well matching with the global performance. But in considering all of these aspects, as a developing and emerging country and one of the states most susceptible to climate change, Bangladesh is worthy of mention over the last decade.

Any state like Bangladesh struggles with a complex issue like climate change, meeting an RE target for securing reliable energy at an affordable cost and ensuring economic growth despite abandoning the comfortable track on which everything will

arise in time. Due to climate change and the energy security issue, the world is eager to exploit RE for producing green energy by following the competitive auctioning scheme.

There are two main arguments often identified as driving the use of RES auctions: Firstly, they allow an efficient allocation of support at a level that is competitively determined and reflects realistic cost for the selected projects at the time when they are implemented. Secondly, they allow for non-discriminatory and competitive volume control of RES deployment (i.e., avoiding first come-first-served schemes) and thus control of total support budgets. Both of these can be attractive to policy-makers faced with growing support commitments that burden consumers/taxpayers (Kitzing et al. 2019). But the empirical evidence proves the advantages of an auction scheme which overcome these arguments in many aspects.

Lower prices are the prime motivation for the espousal of auction schemes globally. In the last decade the prices of solar and wind auction have lessened a lot. In 2010, the global average contracted price for solar energy was around 250 USD/MWh which came at 56 USD/MWh in 2018, i.e., a 78% price reduction in 8 years (IRENA 2019). Similarly, the wind price fell as well; but compared to solar, the reduction was slower than solar. The weighted average price of wind in 2018 was 50 USD/MWh, dropping from 75 USD/MWh in 2010, i.e., a 33% price reduction in 8 years (IRENA 2019).

On the other hand, the reduction of technology cost in the interim led global RE experts and decision makers to accept the auction scheme more robustly as a medium of shaping the market price of renewables in their framework, circumventing windfall earnings for the inventors. For example, a notable price decline occurred for onshore wind in Brazil from USD 28.96/MWh in December 2017 to USD 18.58/MWh in April 2018. For solar PV, 17 GW capacity was solely owed by India at an average price 42.3 USD/MWh, and the Philippines for a 50 MW capacity received bids at a low cost of 43.9 USD/MWh (IRENA 2019).

But still, power projects (both conventional & RE) are awarded on an unsolicited basis (Power Purchase Agreement -PPA/Request for Quotation-RFQ) and tariffs are determined through direct negotiation (between BPDB & Independent Power Producer-IPP) in Bangladesh; and in this regard, the RE price is high compared to global trends. This is the moment where auction schemes should be investigated, since suitable and tailored auction schemes can be a solution to achieve reliable green energy at an affordable cost. So, this research will be a roadmap for achieving the carbon free green energy generation target within the stipulated period for meeting the future with safe and secure energy through a cost-effective auctioning scheme with diverse paybacks.

2. Literature Review

When the auctions are structured analyzing any country's economic, political, and RE goals; only then can it yield positive consequences. The experience gained from different countries may be a guideline for new entrants into the auction world. This section is underlined with theoretical aspects along with some country-specific empirical evidence together with with auction design features.

The 'auction' was first described academically by Columbia University's Professor William Vickrey in 1961 though it had been used by stamp collectors as early

as 1893. In a Vickrey auction, bidders are unaware of the bids of other individuals. The winner of the bid does not pay the winning bid price - they pay the second-highest bid price. In such an auction, individuals are encouraged to bid their maximum willingness to pay. The use of auctions for advancing renewable energy capacity is not a new concept. It was started in 1990s by UK's Non-fossil Fuel Obligation (NFFO) and achieved mixed results at best.

An auction is a selection process designed to procure (or allocate) goods and services competitively, where the allocation is awarded based on financial offers from pre-qualified bidders. When competition is feasible and desirable, auctions have proven to be a very effective mechanism for attracting new players and efficiently matching supply and demand, and they have played a major role in several economic sectors. An auction also increases the transparency of the procurement process, making the resulting obligations less likely to be challenged in the future as the political and institutional landscapes change (World Bank Group 2014). Auctioning plays a remarkable role in various economic sectors, besides the auction process itself being transparent and well accepted by all.

Renewable energy auctions are also known as "demand auctions" or "procurement auctions", in which the government issues a call for tenders to procure a certain capacity or generation of renewables-based electricity. Project developers who participate in the auction typically submit a bid with a price per unit of electricity at which they are able to realize the project. The auctioneer evaluates the offers on the basis of the price and other criteria and signs a power purchase agreement with the successful bidder (IRENA 2015). So, the selection of the winner is solely based on the bid price. "Argentina's RE auction experience to date has demonstrated that RE projects are cost effective against traditional power generation options in that country" (AURES II D2.1-AR 2019, 22).

Auctions provide governments with a market-based framework and an efficient allocation tool to meet policy objectives such as renewable deployment, tariff reduction, reliability improvements, carbon emissions control, economic development, and increased foreign investment. While a variety of policies exist to promote the development of renewable energy, competitive auctions have emerged as a preferred policy for utility-scale renewable energy development. Auctions can be designed to result in procurement of a specific quantity of electricity (or capacity to be built) at a strike price. Renewable procurement schemes can also be designed with a fixed budget, allowing quantity to be determined by the market (Hochberg and Poudineh 2018).

The features of cost-effectiveness, enabling real price discovery in terms of the project and resulting lower support level, mean many countries of the world are shifting to feed-in tariff to competitive auction process (Kreiss et al. 2017). So, the study proposes that the auction mechanism for RE is offering competitive price, faster project execution, easier to scale up for multiple projects and rounds, and thus it attracts multiple bidders.

Auctions are extremely flexible allocation mechanisms, allowing policy-makers to specify when to call for a certain amount of new RES deployment, what technologies are to be supported, which type of support they receive and when projects should be delivered. As with other RES support schemes, the success of auctions

depends on the design elements chosen and how well they address specific characteristics of the technologies and markets (Shrimali et al. 2016).

Auction design is an important concern for policy-makers as because without assessing the real requirements of any country's RE, socio-economic and political goals, auction cannot produce satisfactory outcomes. A lot of studies explain that the auction purpose has not be fulfilled due to lack of inadequate prequalification, technology specificity, pricing rule, auction schedule, auction type, price allocation process, unclear specified penalties, or complex auctioning practice (Kreiss et al. 2017, Kitzing et al. 2019, Rio-Linares 2014, Gephart et. al. 2017, Bayer et al. 2018, Shrimali et al. 2016). As per the report, in 2005 about 6 countries implemented auction/tender system for capacity procurement and in 2018, this number rising to 84 (REN21 2018). The report says that at least 29 states applied RE auction schemes in 2017 and the number is being increased to 41 in 2019 (USAID 2019). So, the competitive auction scheme is catching the attention of the world's policy leaders and gradually its adaption is increasing worldwide.

2.1. Auction features and gains: some empirical evidences

2.1.1. Volume auction

The volume auction refers to the amount of renewable electricity demanded by the auctioneer in each individual auction and the key input to the auction is to impact the expected volume of RE. Auction volume can be defined in terms of capacity (MW), generation (MWh), or budget (million EURO/USD). So far capacity caps have been the most common (Kitzing et al. 2019). A high auction volume may induce additional actors to partake and thus upsurge competition, and accomplish lower prices (Schmidt et al. 2019). "Many believe that because attractiveness for developers, is strong, larger amounts of electricity should be auctioned" (AURES II D2.2-HU 2020, p. 20). According to IRENA (2015), for experiencing wild energy growth and speedy capacity adding in any economy, volume auction is highly acceptable. But target setting must be collaborated with government policies for RE deployment and technical capabilities of existing system to absorb the RE. There are three ways to determine the auction volume: (1) under a fixed volume method; (2) in a price-sensitive demand curve mechanism; and (3) in a multi-criteria volume setting method. Among these three ways, the first one has been the most common option implemented worldwide, and seems to be reasonably functional. Fixed volume approach is beneficial for its simplicity, transparency, and offering guidelines to the bidders. Further, governments can accommodate a limited budget for the support of renewables by implementing a price cap mechanism by this approach.

Relating to this approach, one case of South Africa in 2011 is instructive. For the first round of the auction was not so successful in enhancing a competitive point of view. The first round consisted of a total five rounds for a capacity target of 3727 MW. In different demand bands of the first round, the volume of the auction was not defined. But the second round was successful, as it led to higher participation of bidders and a reduction of price and it was made due to a set volume cap (IRENA 2015).

2.1.2. Regular/systematic auctioning schedule

Systematic auctioning scheme involves a commitment to a longer-term auctioning schedule. This scheme allows market agents to better adjust their expectations and to plan for the longer term. Additionally, introducing a steady stream of new projects rather than a substantial, aperiodic influx (as is typically the case with stand-alone auctions) helps the government to promote the development of a local industry. In addition, having a long-term auction schedule provides better guidance for planning the grid infrastructure, so that the stream of new projects is smoothly integrated. Choosing this option, however, may result in a risk of overcommitment, forcing the government to dynamically adjust the auction schedule and quantities according to perceived shifts in market conditions (IRENA 2015).

Systematic auction schedule decreases risk & increases investors' confidence, reduces bid prices, encourages technological progress and thus reduces technology prices, prevents underbidding as bidders do not need to bid aggressively in a given round to secure a contact, allows potential investors to enter into the market, and follows a learning by doing process (IRENA 2016, Gonzalez 2017, Hochberg–Poudineh 2018, IRENA and CEM 2015, Mora et al. 2017, Wigand et al. 2016).

The National Solar Mission in India aimed to support the development of the solar power sector and committed to a systematic auctioning scheme. Between the first and second round, the total capacity offered in the bids increased by 100%, the percentage of projects installed in a timely manner increased from 89% to 100%, and the price dropped by 28%. In California, four auctions were planned from the get-go, to be carried out in the timespan of two years, with predetermined demand levels (although those quantities were later revised upwards). In Germany, one of the main features of the newly designed auction is the longer-term planning and a pre-commitment to a schedule. Nine auctions were planned over the course of 2015–2017. The reason for having a systematic auctioning scheme is to ensure a continuous renewable energy project pipeline, while at the same time to test different design elements in different auction rounds (IRENA 2015, IRENA 2017).

2.1.3. Technology-neutrality of auction

Technology-neutral RE auctions are competitive bidding processes without any formal restrictions on the participation of available technologies, in which neither negative nor positive technology-specific discriminatory rules exist. This design (1) minimizes generation cost; (2) ensures compliance with applicable regulation demand-no technology discrimination; and (3) encourages more actors to participate as more technologies are included. Finally, if the aim of auction is to minimize costs, a technology-neutral auction can be initiated, allowing competition between technologies, therefore favoring the more mature and cost-competitive one (Gonzalez 2017, IRENA and CEM 2015, GIZ 2015, Wigand et al. 2016, Mora et al. 2017, Roy et al. 2016, Mora et al. 2017 (D9.2)).

As per USAID auction toolkit (2020), a recent example of this type of auction, which uses bidding on premiums to renewable generators selling into the wholesale electricity market, is the successful technology-neutral auction held in Finland in 2019. In this auction, 1.36 TWh of energy was contracted at an average premium of €2.51

(2.95 USD) per TWh. "In 2017, Chile introduced technology-neutral auctions that included both conventional and RE plants. Bidders bid into hourly and seasonal time blocks, reflecting different power system needs. This design enabled RE projects to win 100% of the offered capacity" (USAID 2019, p. 15).

2.1.4. Site-specificity of auction

In site-specific auction, the government selects the project site and pre-develops the site either partially or fully. Here government defines a target volume for the auction round and bidders then compete for the right to construct their projects at the specific site. This type of auction allows for better coordination between project construction and required grid expansion. Site-specific auctions reduce the risks and costs associated with the project development process for bidders. But faulty pre-development work would reduce this benefit. In Zambia's first auction round, site selection issues on the project sites led to additional development work after project award. (USAID 2019).

Site-specific auction has probably reduced risk and transition costs for producers which was reflected in the lower price level. Further, auction was organized in specific areas with very good RES and after an extended time without a scheme, demand was higher. A Portuguese 1400 MW capacity auction was implemented in this way (AURES II D2.1-PT 2019).

2.1.5. Pay-as-bid pricing rule for auction

In the arena of RE auction, pay-as-bid pricing mechanism is the most common approach. By pay-as-bid pricing rule, auction bidders pay their reported demand for each unit they obtain and winners are awarded the remuneration for which they bid (Haelg 2020).

Pay-as-bid implementations are typically seen as a means to minimize costs, offering bidders no more than their bid, which is supposed to be the minimum required for developing the renewable energy project. This gives these schemes much wider appeal from a social and political standpoint. The cost-effectiveness of the auction mechanism tends to be an important driver behind the widespread adoption of pay-as-bid pricing (IRENA 2015). Pay-as-bid pricing may favor more financially viable projects with a higher likelihood of on-time implementation (Shrimali et al. 2016). Renewable energy projects implemented by Argentina, Hungary, Mexico, Portugal, Ukraine have followed a pay-as-bid pricing rule in auction features (AURES II 2019, AURES II 2020).

2.1.6. Ceiling price allocation process for auction

A ceiling price acts to avoid excessive producer's revenue when there is little or limited competition in the auction. Disclosing the ceiling price to bidders in advance prevents otherwise qualifying projects from being rejected simply because bidders did not know the ceiling price. The disclosure of the ceiling price also gives bidders more planning security (USAID 2019). The ceiling price allocation process can prevent excessive prices and may prevent collusion and price manipulation. High ceiling prices attract more participants, though potentially weaker ones. This process can help government to acknowledge up front that there is a risk whether the auction scheme may fulfill its

intended role (achieve low cost) or not (Gonzalez 2017, IRENA and CEM 2015, Gephart 2017). So, a ceiling price is a maximum price above which bids will be disqualified.

The auctioneer needs to decide whether the ceiling price should be disclosed prior to the auction. Full disclosure tends to involve a slightly greater degree of transparency, but in the case of limited competition may result in bids that are just below the ceiling price. Leaving the ceiling price undisclosed can result in disqualification of otherwise sound bids that are only slightly higher than the ceiling price. By introducing a ceiling price, there is an upfront acknowledgement of a risk that the auction scheme may not fulfil its intended role of achieving low prices and that, as a result, the auctioned volume will not be fully contracted. In South Africa, the disclosure of the ceiling price combined with the lack of a strict volume cap resulted in high prices. The subsequent rounds, with undisclosed ceiling prices and well-defined volume caps, led to significantly lower prices. The intense competition in the Indian auction meant that the "anchoring" caused by the disclosed price caps was of little concern (IRENA 2015).

2.1.7. Hybrid auctioning type

Hybrid type auction defines an auction where the first phase follows as a descending clock auction and in the second phase operates as a pay-as-bid sealed-bid auction. The aim of the hybrid auction is to take the benefit of price discovery via descending clock auction and to avoid collusion between small quantities of participants for fixing the final price via seal-bid auction (IRENA 2013). This type of auction may allow for real price discovery (ceiling price) in a dynamic auction and prevent collusion thanks to a subsequent seal-bid auction (Gonzalez 2017). Hybrid auction may be little bit complex; but real price detection and conspiracy prevention are possible here.

Brazil, in its auction process, has combined a descending-clock auction followed by a pay-as-bid round. The auctioneer positively decreases prices, collecting investor's quantity bids, until a point when overall supply is greater than demand by a certain factor, unknown to the bidders. After this, a sealed-bid auction takes place (IRENA 2015).

2.1.8. RE-plus-storage

To help utilities, grid operators, and customers with better integrated distributed RE generation by maintaining grid stability and reliability, RE-plus-storage is another increasingly popular strategy to address the timing of energy output. To enhance dispatchability and to improve value of energy, many countries around the world are using this RE-plus-storage.

For example, in December 2019, the Solar Energy Corporation of India (SECI) held an auction for 1.2 gigawatts (GW) of dispatchable RE-plus-storage capacity. The plants must be available during peak hours, which are specified by SECI as 5:30 to 9:30 a.m. and 5:30 p.m. to 12:30 a.m. daily (USAID RE Auction Toolkit 2020). As per National Solar Energy Federation of India (NSEFI) of May 2020, the recently concluded 400 MW renewables auction to supply 24-hour electricity saw a winning bid of INR 2.90/kWh (0.04 USD/kWh) – a new milestone after peak & off-peak tariff on INR 4.07/kWh (0.055 USD/kWh) was achieved in December 2019's 1.2 GW auction seeking assured power supply during peak-demand hour (NSEFI news portal).

2.1.9. Qualification requirement in auction design as a socio-economic development instrument

Qualification requirements to promote socio-economic development will be aimed at local industry development or local empowerment and employment. The qualification requirements can be a means to ensure that the bidders have the financial, technical, and legal capability to develop the project. In line with the country's overall objectives, policy makers can introduce design elements to maximize socio-economic benefits from renewable energy deployment. Usually, these goals are reached either by imposing qualification requirements or by introducing a criterion in the winner selection process (IRENA 2015). Auctions can also include local content requirements/socio-economic development requirement to ensure the development of industries, creation of jobs, local industrial development in the renewable energy sector (IRENA 2013). Qualification requirements and/or penalties are useful auction design elements to increase the implementation rates of selected projects (Gephart et al. 2017). Hence, the qualification requirement with socio-economic development instrument can ensure diverse paybacks to the country.

For instance, projects awarded in Morocco have been reporting the benefits achieved due to inclusion of socio-economic development goals as qualification requirement. Morocco's 'Noor-Ouarzazate' RE project consisted of four phases. Noor I phase indeed sourced 30–35% of the project cost in local components and services. Throughout the four phases, 70% i.e., 6,430 Moroccans were employed and a third of the jobs were sourced locally from the region of Ouarzazate. Again, South Africa's 'Renewable Energy Independent Power Producer Procurement Program (REIPPPP) consisted of a total of seven rounds that attracted 14.64 billion USD by March 2019. When it comes to local content, 3.27 billion USD were spent locally out of total spending of 90.3 billion USD. In terms of job creation, the REIPPPP has created a total of 40,134 job-years for South African citizens. The procurement was surpassed with local equity shareholding across all arounds reaching 52%. The REIPPPP contributes to Broad Based Black Economic Empowerment (BBBEE) and the creation of Black industrialists and Black South Africans means own on average 33% of the projects (IRENA 2019).

3. Methodology

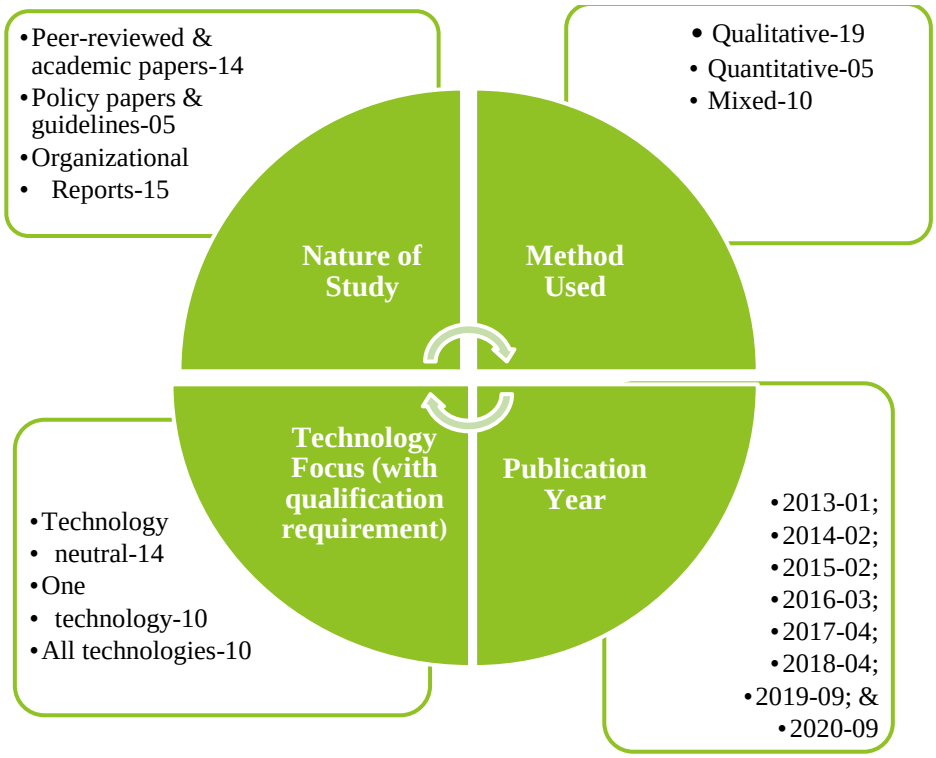
The research is mainly qualitative in nature. For the qualitative part, i.e., for probing the suitable auction design process, it has been piloted on the basis of a systematic literature review focusing on three aims: first, to find out the potentiality of auction; second, to identify the design features of the auction, and third, to find out the gains of the auction following some country-specific empirical evidence.

For examining how auctions are used in relation to cost-effective renewable energy deployment, a systematic literature review that comprised a reproducible search and applied explicit criteria for the inclusion and exclusion of studies was conducted (Sovacool et al. 2018). A semi structured approach was used based on Petticrew and Roberts (2006).

In the abstract database Scopus, peer-reviewed literature assembled via a keyword search and 'renewable energy auction design' was identified. In the next phase, a snowball sampling round was conducted for the cited articles in the preliminary phase (Cooper 1998). Further, some country-specific policy reports, guidelines, organizational reports, and policy papers have been added here as those have helped to give feedback about the literature of auction design and paybacks amounting to a list of articles from 54 studies.

Out of these studies, highlighting a link between auction design, gains, and country-specific evidence, the list was narrowed down to 34 studies summarized in figure 1 which presents them according to the nature of study, its technology focus, its year of publication, and usage of method. Most of the studies were qualitative in nature.

Figure 1 Compressed qualitative summery



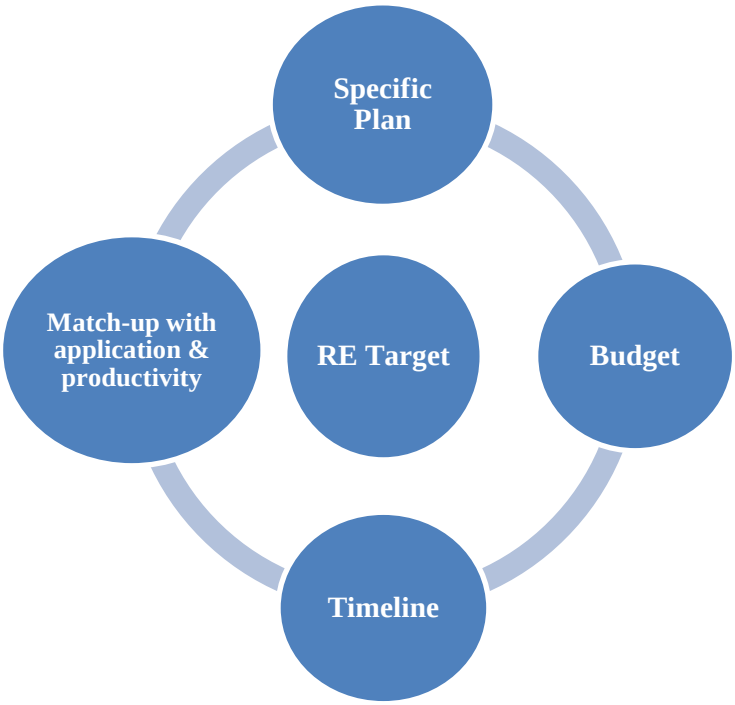
Source: own construction based on the characteristics of articles

Based on the 34 studies, a list was compiled concentrating on the features of auction design, auction pricing rule, technology specificity, location specificity, auction volume, and the outcomes of the auction. Specially, how an auction design feature with systematic scheduling mixed with socio-economic development instrument under qualification requirement resulting in diversified gains was searched for by the qualitative screening of the studies.

4. Results

Like many countries, Bangladesh is one of the world's speedily growing developing economies aiming to face the vulnerability to climate change by keeping its progress phase steady. Focusing on these two decisive aspects necessitates the insertion of sustainable and renewable energy sources into the country's long-term growth target. A clear-cut vision supported by structured strategies are indispensable for the development of any sector, and renewable energy is not far beyond of that. For meeting the RE target, any country needs a mingling of specific plan, budget, timeline, and match-up with application & productivity (see Figure 2).

Figure 2 Requirements for meeting RE target



Source: Own construction based of discussion

In meeting the high volume RE target (see Table 2) by stipulated period for gaining 100% carbon free energy generation, auction will be an effective measure. The result of the literature review (see Table 1) suggests that only a decent handful of auction design features can directly and indirectly ensure diverse paybacks.

Table 1 Summary of the literature review

Auction Feature	Paybacks/gains
Auction/demand auction/competitive bidding	Ensure transparency in energy procurement process; offer competitive price; help to deployment of targeted amount of RE within fixed budget; offer faster project execution, reduce windfall profits for power producers; scales up multiple projects and attracts multiple bidders
Volume Auction	Support for high energy growth & speedy capacity adding; attract more bidders; upsurge competition; accomplish lower price
Regular/systematic auctioning schedule	Promote the development of local industry; better guidance for placing the grid infrastructure; decrease risk & increase investor confidence; reduce bid price; encourage technological progress thus reduce technology prices; prevent underbidding as other projects are in the pipeline; learning by doing process
Technology-neutrality of auction	Minimize generation cost; ensure compliance with applicable regulation demand; encourage more actors to participate for inclusion of more technology
Site-specificity of auction	Bangladesh has land scarcity. For ensuring grid connectivity of RE, this feature is effective. This feature encourages participation & competition; ensures lower participation cost & risk; attract new market entrants; achieve geographical diversity
Pay-as-bid pricing rule	Minimize cost of RE; actual discover of real demanded price; favor more financially viable projects
Ceiling price allocation process	Prevent excessive price, collusion & price manipulation; attract more participants even potentially weaker one; help government to acknowledge upfront that there is a risk whether the auction scheme may fulfill its intended role or not
Hybrid type auction	Provide benefit of price discovery; prevent collusion between small quantity of participants for fixing the final price
RE-plus storage	Recently developed auction strategy that improves the value of energy; enhance dispatchability; and help utility, grid operators & customers with better integrated distributed RE generation by maintaining grid stability & reliability
Qualification requirement in auction design as socio-economic development instrument	Ensure local industrial development; gear up local empowerment; create new employment generation; facilitate regional economic development

Source: Author's own creation based on literature review

It is vital for any developing country like Bangladesh to prepare for the near future when the stock of the non-renewable fossil fuels will be on the verge of depletion globally and environmental mishaps will pose an added menace for livelihoods. Due to the increase of the efficiency of technology, the coming future will surely see the reduced price of RE. The universal picture is robustly updating, and the share of RE in the energy-mix is enhancing day by day. This highlights the philosophy of sustainable and affordable

uninterrupted quality energy for everyone by 2021, Bangladesh has introduced some measures (specially for RE expansion) lining up with global actions (we can call those 'with existing measures-WEM'), such as:

- Large-scale grid tied solar PV projects (3 MW-200 MW capacity)
- Solar home system (SHS)
- Solar mini grid (SMG)
- Solar irrigation pump (SIP)
- Net energy metering for rooftop solar PV system
- Solar drinking water
- Solar power telecom tower
- Solar street light
- Solar charging station

In that any emerging economy like Bangladesh which is provided with renewable energy sources and which does not yet follow auction process, technology-neutral site-specific volume auction systematically scheduled combined with socio-economic development instruments under qualification requirement can make it beneficial by confirming diversified gains through practicing the features mentioned.

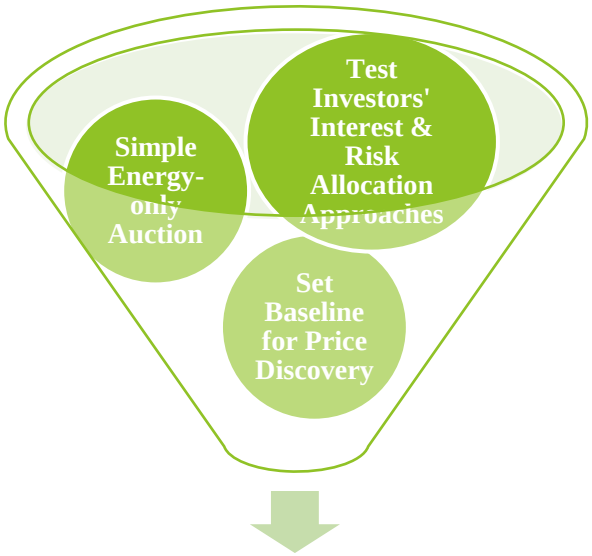
5. Conclusion and future policy implications

Over the last decade, auction schemes have been used as a RE-support and the sharing of grid connection capabilities have been an operative feature. RE-plus-storage is a new dimension in this arena. Renewable energy sources have become economically competitive with fossil fuels in many jurisdictions while being a totally environment friendly and supportive tool to reduce GHG emission further. In coming years, RE will become cheaper than any fossil fuel-based energy by following an auctioning mechanism. Cheaper power from RE sources will be the chief driving force in the energy industry. After robust initiation of RE, the backward and forward linkages will expand, no doubt. India is good example of this claim. Systematic auction scheme will keep RE projects in the pipeline.

In this paper, the analysis of various literature findings on some auction design features and their returns on auction consequences may also assist policymakers in estimating probable paybacks of their design choices for early-auction and thus valuate trade-offs among different auction designs and qualification requirements.

Gaining the proposed goals (see Table 2), auction should be introduced in unsolicited form for awarding projects in the power sector. The first auction does not have any complex feature like requirement for forecasting and reactive power compensation equipment. As per USAID auction toolkit (2020), the prime purposes of early auction creators are to reveal market interest and to commence the process of price discovery (see Figure 3). It says that in first auction, France quoted 88 MW solar PV for its first year; India 208 MW; Greece 40 MW for its pilot solar auction; and Poland quoted 8 MW for wind and 70 MW for solar.

Figure 3 Early auction objectives



Source: own creation based on RE auctions toolkit, USAID 2020

The auction features mentioned (see Table 1) can help to achieve the objectives of early auction in an effective way. Along with that in the early auction, auction designers should pay special attention to (1) the government having to take on the risk of land (i.e., land development, land allocation, site selection) and the participants in the auction taking on the risk of investment and operation; (2) auction will be called for high voltage power generation from RE (i.e., hub based RE); (3) enhancing competition as well as the efficiency of public sector, the government has to build up a public entity that will participate in the auction process along with private entities; (4) the qualification requirements must be easy but have to be focused on the benefits of local socio-economic development; and (5) emphasizing timely completion of RE projects.

Up to June 2020, only 650 MW of electricity produced from RE was added to the energy-mix in Bangladesh. Inconsistency with the different policies and lack of more effective actions are the significant barriers for achieving an RE target within a stipulated time frame. For this, aligning with the 'Draft National Solar Energy Roadmap of Bangladesh 2021–2041', the RE target can be set as follows (see table 2)-

Table 2 Proposed RE production and expected CO_2 emission reduction target for Bangladesh

Scenario		Unit 2020	Unit 2021-2030	Unit 2031-2041	Cumulative
BAU (10%)	Capacity (MW)	650	1,961	3,493	6,104
	GHG (MtCO2)	570,679	2,049,673	3,650,884	6,271,236
Medium Case (20%)	Capacity (MW)	650	3,922	6,986	11,558
	GHG (MtCO2)	570,679	4,099,346	7,301,768	11,971,793
Higher Medium Case (35%)	Capacity (MW)	650	5,086	15,547	21,283
	GHG (MtCO2)	570,679	5,315,475	16,250,168	22,136,322
High Case (50%)	Capacity (MW)	650	9,743	19,711	30,104
	GHG (MtCO2)	570,679	8,092,984	22,692,337	31,356,000

Source: Author's own creation based on 'Draft National Solar Energy Roadmap 2021-2041' for Bangladesh

As explained earlier, worldwide the technological advancement of the RE sector is eye catching and in near- future, development will be vigorous. Consequently, achieving any realistic target will not remain merely a dream. Here it must be mentioned that 24-hour if total electricity load is 100%, then 60% is all time load demand, 20% is intermediate load/day-peak demand, and 20% is evening-peak demand in Bangladesh. The justifications for setting target (see Table 2) for Bangladesh are (see Table 3):

Table 3 Justification of RE target setting in Bangladesh

Scenario	Cumulative Target (till 2041)	Justification to fit with RE Target
Business as Usual (BAU)-10% of RE of total electricity production	• 6104 MW RE • 6271236 $MtCO_2$ emission reduction	Being coherent with various policies (i.e., energy policy, power sector master plan 2016) set by the government of Bangladesh
Medium case-20% of RE of total electricity production	• 11558 MW RE • 11971793 $MtCO_2$ emission reduction	20% is intermediate load, i.e., day-peak demand is met-up by liquid fuel. Per unit liquid fuel cost: furnish oil 0.11 USD and LNG 0.10 USD. If per kWh RE generation especially solar cost is below 0.10 USD, then the target will be achieved. Recent global

		price trend shows that RE generation cost is below 0.10 USD/kWh. Again, currently 16 rental & quick rental power plants are active in Bangladesh whose capacity is 1109 MW and its per kWh generation cost is 0.099 USD. The contact tenure of these plants will be ended in 2024 (source: Bangladesh Power Development Board). It is a debatable issue whether the government should run the rental & quick rental power plants considering environmental issue. If the contact tenure is not being extended further, then this Cen percent share can be replaced by RE.
Higher Medium case-35% of RE of total electricity production	• 21283 MW RE • 22136322 $MtCO_2$ emission reduction	Bangladesh foresees rapidly moving towards a developed economy by 2041. Currently it is developing one. When it adopts that direction then economic progress and industrialization will be further expedited, then the evening-peak demand will be shifted along with intermediate load. Then 35% target of 40% demand (i,e., 20% day-peak demand plus 20% evening-peak demand total 40%) can be covered by RE analyzing economic viability, i.e., generation cost below 0.10 USD/kWh.
High case-50% of RE of total electricity production	• 30104 MW RE • 31356000 $MtCO_2$ emission reduction	Time to time revision of policy, technological advancement of RE, robust expansion of RE sector in Bangladesh, and matching-up with grid integration & variable renewable energy (VRE) will help to reach that aim.

Source: Author's own creation

In addition to the discussion of this paper, some supplementary recommendations practiced by developed countries for RE-support for obtaining high level expansion of RE can be presented as follows, which can be treated as WAM (with additional measures):

- Reliable and perfect RE mapping are required, i.e., determine solar and wind hubs for getting full advantage of RE;
- Set realistic RE target and coherence of all policy documents for chasing a single goal;

- Use of innovation technologies, i.e., energy storage, increase capacity of existing network elements, and operating modes, i.e., demand side responses;
- Independent aggregators especially for energy communities, i.e., relation to households and small corporate consumers for exchanging day-ahead market (DAM) and intra-day market (IDM);
- Obligatory Solar Home System (SHS) and net metering for new high-rise buildings, industries and commercial establishments including Export Zones (EZs) and Export Processing Zones (EPZs);
- Fix a single responsible point for achieving the RE target within stipulated time period avoiding the involvement of other energy segments;
- Interest free/negligible level of interest (2%-3%) based credit scheme for supporting, operating, and integrating RE generation market;
- Development of metrological centers by supporting high level of forecasting to the national load dispatch center for taking prior back-up plan to generate electricity from conventional sources;
- Introduce policy for large storage system (grid) for peak-shifting and saving for load/generation and eliminate variability in RE generation;
- RE deployment should be connected with 'Distributed Renewable Energy (DRE)';
- Develop regional cooperation in the RE sector, such as Renewable Energy Coordination Group (RECG) for trading cost-effective cross-broader RE;
- Set up standard RE quality control department (QCD) for standardization of RE accessories;
- Initiate 'Green Tariff' for RE sector;
- As electric vehicles (EV) are a good source of energy storage, government should take initiatives to promote their use;
- Improve specialized education for the labor market in the RE sector;
- Improve employment prospects in the green energy sector;
- Allocate subsidy/incentive for a huge expansion of the RE sector.

Declaration of Competing Interest

The author declares that he has no known competing financial interests or individual connections that could have influenced the work presented in this paper.

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Aid for trade policy effectiveness and the middle income

Timothy Yaw Acheampong

The COVID-19 pandemic has made it necessary for all countries and donors to re-evaluate the effectiveness of development policies as countries across the globe seek to reverse the negative growth rates and set their economies back on the path of recovery following the worldwide recession caused by the pandemic. The Aid for Trade (AfT) policy commenced in 2006 with the objective to promote economic growth in developing countries through export expansion. AfT has 3 main components, namely, Aid for Policies and Trade Adjustments, Aid for Trade Infrastructure, and Aid for Building Productive Capacity. Considering that economic growth is a prerequisite for escaping the Middle-Income Trap (MIT), this study seeks to investigate the potential role of AfT in helping countries escape the MIT by answering the following question: How has each of the 3 components of AfT impacted economic growth in middle-income countries? To answer this question, data for 73 middle-income AfT beneficiary countries over the period 2008-2018 were analysed using hierarchical multiple regression, dynamic panel regression, and quantile regression models. The findings suggest that AfT can contribute to growth but it cannot be relied upon as the main engine of growth and vehicle for escaping the MIT.

Keywords: *Aid for Trade, middle-income trap, economic growth*
Jel code: *F35, F43, O11, O57*

Introduction

Before the onset of the COVID-19 pandemic, many middle-income countries were grappling with what has been described in recent economics literature and development circles as the 'middle-income trap' (MIT) – a relatively new concept that describes the challenges middle-income countries face in advancing to high-income status. Estimates from the world bank indicate that only 13 out of 101 middle-income countries in 1960 were able to advance to high income by the year 2008 (World Bank 2012). The fact that a very limited number of countries are able to advance from middle income to high income has intrigued researchers whiles prompting policy makers and international development organisations to seek solutions due to excessive inequality and lack of social protection in affected countries (Foxley 2016; Glawe–Wagner 2016).

The challenges facing middle-income countries have been made even worse by the COVID-19 pandemic. Whilst the COVID-19 pandemic has impeded economic growth globally in all regions of the world (HLPE 2020, IMF, 2020), middle-income countries have been among the most affected (World Bank, 2020). For instance, an estimated 72 million representing about 80% of the new people who have now become poor as a consequence of the COVID-19 pandemic are in middle-income countries (World Bank, 2020). To make matters worse, the rate of unemployment was also projected to increase by 10% in middle-income countries as a result of COVID-19 (IMF, 2020). IMF (2020) also points out that global growth contraction as a result of the

pandemic for 2020 is estimated at – 3.5 percent, and recovery is going to be more difficult for middle-income countries compared to the advanced countries. Therefore, economic recovery from the pandemic and escaping the MIT would require innovative and more sustainable sources of economic growth.

Since the introduction of the MIT concept by Gill and Kharas (2007), several researchers have investigated the causes and possible solutions to the MIT. Low human capital, unfavourable demographics, weak governance and institutions, poor infrastructure, structure of economy, and low technological development are some of the factors that have been attributed to the MIT in the literature (World Bank 2012; Aiyar et al. 2013, Glawe–Wagner 2016, WEF 2016, Wang et al. 2018). Nevertheless, these factors are still inconclusive and debated in the literature (Leven 2019). That notwithstanding, there is a general consensus that some level of sustained economic growth is required for countries to escape the MIT (Acheampong–Udvari 2020, Leven 2019). As Foxley (2016) has observed, the MIT is characterized by a slowdown in growth due to an inability to achieve continuous improvements in competitiveness and productivity. Thus, Felipe et al. (2012) posits that escaping the MIT would require an annual growth rate of at least 3.5 and 4.7% sustained for a period of 14 and 28 years for upper-middle-income and lower-middle-income countries respectively.

In recognition of the importance of economic growth in improving the development status of nations, the Sustainable Development Goals (SDG) 8 has a target to sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries by 2030 (UN, 2015; UN, 2017). Meanwhile, economic growth is determined by the interaction of several endogenous and exogenous factors such as foreign direct investment (FDI), foreign aid and international trade (Todaro and Smith, 2015). As part of efforts to promote economic growth in developing countries, the Aid for Trade (AfT) policy was officially launched by the OECD and WTO in December. The AfT policy was developed in recognition of the potential of international trade as an engine of economic growth and poverty reduction coupled in view of the evidence that participation in international trade has been unequal over the years, with developing countries being more disadvantaged (OECD – WTO 2019). The objective of the AfT was therefore to have official development assistance (ODA) specifically targeted at activities that facilitate export expansion and diversification in developing countries with the view to bolstering the contribution of exports to economic growth with the expectation that this growth would translate into sustained poverty reduction (OECD – WTO, 2011, 2017 2019). AfT has 3 main components, namely, (1) aid for building trade infrastructure, (2) aid for building trade capacity, and (3) aid for trade policies and regulations (OECD – WTO, 2011, 2017, 2019). A study conducted by OECD and WTO in 2011 indicates that economic growth is one of the most important goals that both donors and recipient countries would like to achieve with AfT.

Since the inception of AfT policy about 15 years ago in 2006, over USD 400 billion of ODA have been disbursed to build trade capacity in developing countries (OECD – WTO 2019). Several empirical studies have also investigated the impacts of AfT on various dimensions of economic development. For instance, various empirical studies have found that AfT has a positive effect on multiple measures of export performance, poverty reduction, total employment, and attracting FDI (OECD – WTO

2019). What is still missing in the literature is the direct impact of total AfT and the various components of AfT on economic growth. Furthermore, studies on AfT have also not concentrated on middle-income countries and the potential of the AfT to help these countries to escape the MIT. Since the main objective of the AfT is to promote economic growth in developing countries through export expansion, could the MIT help countries to escape the MIT? Which of the 3 components of AfT has the greatest impact on economic growth, thus, the greatest potential for escaping the MIT?

To answer the research questions, this study uses dynamic panel and quantile regression models to analyse the impact of AfT and its components on economic growth in 73 middle-countries between 2008 and 2018. The next section discusses the concept, theoretical background, and empirical literature on the MIT and AfT. This is followed by an overview of the methodology and the data. The paper concludes with the key findings, conclusions and recommendations.

2. Theoretical and conceptual issues

Both the concept of MIT and the AfT policy appeared in the economics literature around the same time. The term 'middle-income trap' first appeared in a World Bank report authored by Gill and Kharas (2007), whereas the AfT initiative was officially launched in December 2005 but the implementation began in 2006, a year before the introduction of the term MIT. Although both concepts have received enormous attention over the past decade, the nexus between AfT and the MIT is yet to be empirically examined.

2.1. The middle-income trap

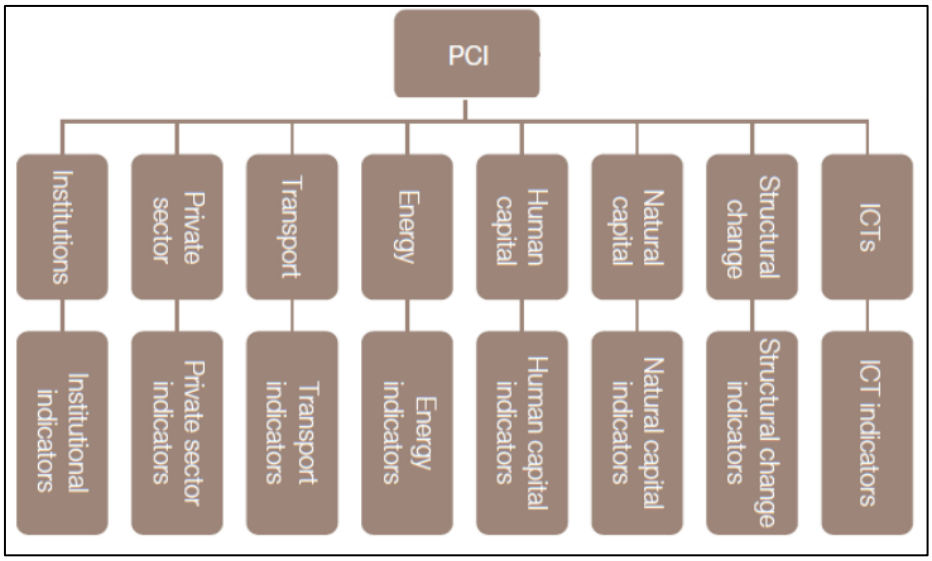
The MIT as a concept is still emerging with various definitions and approaches in determining which countries are "stuck in trap" in the literature (Glawe and Wagner, 2016). Nevertheless, Foxley (2016) concludes that the MIT is characterized by the following three related conditions: (1) a slowdown in growth due to an inability to achieve continuous improvements in competitiveness and productivity; (2) excessive inequality and lack of social protection; and (3) the inability of the institutional system to provide stability, transparency, and good governance.

Some authors also attribute the MIT to institutional and structural issues within an economy such as bad governance, weak institutions, poor infrastructure, and low human capital as well as the level of technological development (Aiyar et al. 2013, Eichengreen, Glawe–Wagner, 2016, 2018, Ohno 2009; Soyyigit 2019; World Bank 2012; WEF 2016). Other authors also define the MIT in terms of economic growth stagnation that keeps countries within the middle-income bracket for a long period of time (Eichengreen et al. 2013; Aiyar et al. 2013; Felipe et al. 2012; Gill–Kharas 2007, 2015; Glawe–Wagner 2016, 2018). Some authors posit that countries must remain in the middle-income bracket for at least 40 to 50 years to be considered as being trapped in the MIT but the exact duration is still inconclusive.

The World Bank classifies countries into 4 income groups, namely, high-income, upper-middle-income (UMI), lower-middle-income (LMI), and low-income, based on their annual gross national income (GNI) per capita calculated on the basis of the Atlas Method. Based on the World Bank's classifications, countries in the high-

income bracket are considered as developed, whereas those in the other income brackets are considered as developing countries. Similar to the views expressed in MIT studies discussed above, a recent study by UNCTAD (2021) in the development of the Productive Capacities Index (PCI) has found that the productive capacities of countries related to structural change, human capital, energy, institutions and ICTs differ by income groups with the more developed countries having higher scores on the PCI. In this regard, UNCTAD (2021) has also argued that investments in the productive capacities of countries is a key for escaping the MIT. Furthermore, the PCI is a framework that can "enable policymakers to understand the time and capacities needed to break the middle-income trap and lay the foundation for inclusive and sustainable economic growth and development" (UNCTAD, 2021, 32–33).

Figure 1 Productive Capacity Index and components



Source: UNCTAD (2021, 15).

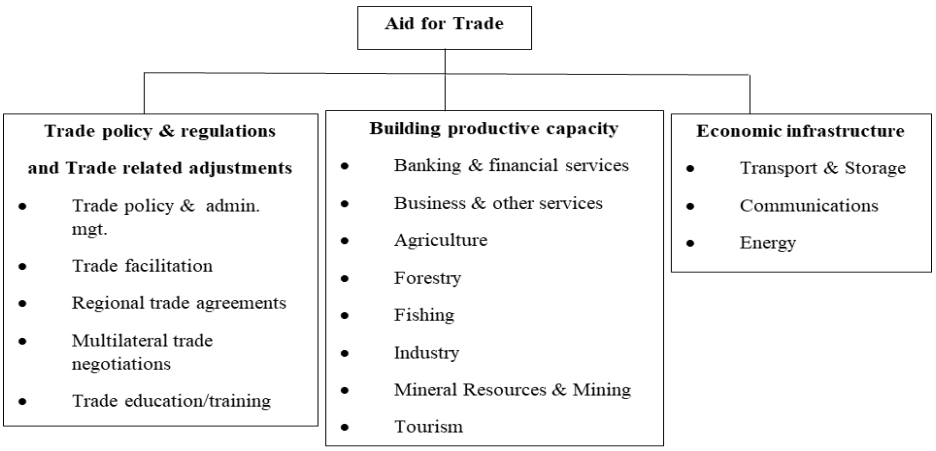
The various perspectives about the MIT have also informed various policy prescriptions on how countries can escape the MIT. Although different solutions have been proposed for escaping the MIT, it can also be concluded that the MIT is a complex phenomenon that is influenced be the interplay of several factors, as noted by Foxley (2016) and UNCTAD (2021). Furthermore, escaping the MIT requires sustained economic growth (Acheampong and Udvari, 2020) although the exact engines of achieving this growth is still inconclusive. Considering that the MIT is still an evolving phenomenon and that the solution has been elusive, this paper explores the potential role of AfT in helping countries escape the MIT.

2.2. The Aid for Trade Policy

The Aid for Trade (AfT) policy initiative was introduced by the Organisation for Economic Co-operation and Development (OECD) and the World Trade Organisation (WTO) in 2005 in recognition of the potential of international trade as an engine of economic growth and poverty reduction. As a part of efforts to assist developing countries address the supply side factors that inhibit their export diversification and effective participation in international trade, the AfT was introduced with the view that it could also enhance growth prospects and reduce poverty in developing countries (Udvari 2014, WTO – OECD 2019).

According to the OECD – WTO (2017), AfT flows are a subset of ODA which is defined by the OECD as grants and loans provided by the official sector with the main objective to promote economic development and welfare of developing countries. ODA and aid-for-trade flows are reported as gross disbursements in million US dollars. AfT flows are classified under 3 broad categories, namely, (1) aid for trade policy and regulations and trade-related adjustment (AfPR); (2) aid for economic infrastructure (AfEI); and (3) aid for building productive capacity (AfBPC). Figure 2 outlines the components of each of the 3 categories of AfT.

Figure 2 Components of Aid for Trade



Source: Author's construct based on OECD – WTO (2019, 519-525).

2.3. Empirical studies on Aid for Trade

Empirical studies on AfT have predominantly focused on the impact of AfT on exports. These studies have generally found positive impacts. Ghimire et al. (2016), for instance, found a positive and significant effect of AfT on multiple measures of export performance, however, with diminishing returns. Zarzoso et al. (2017) also investigated the effectiveness of AfT using a panel quantile regression approach and found that AfT has a positive impact on exports, particularly for countries that export less in volumes. Hühne et al. (2014) also found that AfT has a positive impact on the exports of beneficiary countries to donor countries as well as imports of beneficiary countries from donor countries.

Besides the impact of AfT on exports, some researchers have also investigated the impact of AfT on other economic variables. For instance, Lee – Ries investigated the impact of AfT on FDI and found that AfT had a positive impact on bilateral greenfield investment, noting that aid for trade for infrastructure and productive capacity are strongly associated with investment. Similarly, Roy (2017) noted that AfT can play a supportive role in improving the policy environment and helping beneficiary countries to attract FDI. Durowah (2017) also anlysed the role of AfT and FDI in poverty reduction based on panel data for 91 developing countries and found that AfT has a positive effect on poverty reduction although the impacts differed by countries. In spite of the positive findings, Jakupec and Kelly (2015) concluded that the paramount aim of AfT, which is to reduce poverty in developing recipient countries, has to a great extent not been achieved. At the same time, the existing studies suggest that AfT has positive impacts on exports and FDI, which can both positively impact growth, the impacts of AfT on growth, which is the ultimate aim of the AfT policy initiative, has received little attention in the literature. The objective of this paper is to fill this empirical gap and contribute another dimension to the evolving MIT literature by investigating the potential role of AfT in promoting growth in middle-income countries. If it is found that AfT positively contributes to economic growth, then it could be concluded that AfT has the potential to help countries to escape the MIT.

3. Materials and methods

Since the objective of this study is to explore the potential role of AfT in escaping the MIT, the study has concentrated on AfT beneficiaries that were classified as middle-income in 2006 when the AfT policy began. In order to include as many countries as possible, the study period spans from 2008 to 2018 due to data constraints. Based on World Bank historical classification of countries, in the year 2006 when the AfT began there were a total of 95 countries classified as middle-income. Out of the 95 middle-income countries, OECD data indicates 83 of these countries have been recipients of aid for trade (See Table 1). Out of the 83 AfT recipient middle-income countries, 73 constituted the final sample due to incomplete data on the various variables (See Appendix 1 for the list of countries). Table 1 also summarises the key variables and sources of data for this study.

Table 1 Study variables, measurements, and data sources

Variable	Measurement	Source
Aid for Trade (AfT) Components (See Figure 2)	Current USD in millions - Average of sub-components	OECD
Total export of goods and services	USD current prices in millions	UNCTADstat
GDP	USD at constant prices (2015) in millions	UNCTADstat
GDP per capita	USD at constant prices (2015) per capita	UNCTADstat
Productive Capacity Index (CPI) components (See Figure 1)	Score: 0-100	UNCTADstat
Foreign Direct Investment (FDI)	US dollars at current prices	UNCTADstat

Source: own construction

Data analysis

The data were analysed using descriptive statistics, correlation analysis, and regression analysis. The descriptive statistics were used to understand the distribution of the key variables, while correlation analysis was used to test if there were any significant statistical relationship between the study variables. The descriptives and correlations were also informed the regression models used in this study. In view of the study objectives, 3 different multiple regression approaches were used. These approaches were hierarchical multiple regression (also called sequential regression), dynamic panel regression, and panel quantile regression. Before conducting the analysis, preliminary robustness tests were conducted to ensure that the assumptions of normality, linearity, homoscedasticity, independence of residuals were not violated. In order to address issues of endogeneity as many relevant variables as possible were considered whilst the analyses were also disaggregated to the income group and country levels.

Regression models

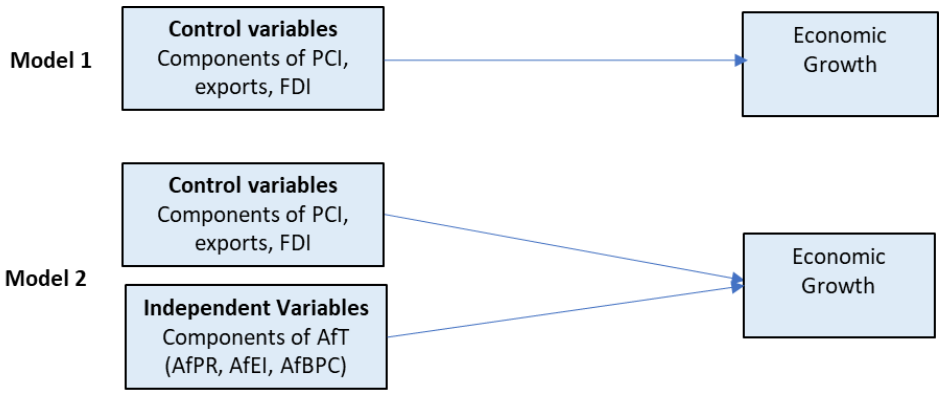
The general static model for this study can be represented by the following equation:

$$y_{it} = \alpha_i + \beta_i X_{it}{}' + e_{it} \quad (1)$$

Where *y* is the dependent variable (economic growth – LnGDP, LnPercaitaGDP, and LnGNIpercapita); α is the constant; β is the coefficient for the set of $X_{it}{}'$ independent variables (LnAfPR, LnAfEI, LnAfBPC, ZFDI, Human Capital, Institutions, Energy, Private Sector, Structural Change, ICTs, Transportation) for 'i' cross sections (73 countries) and 't' time periods (11 years).

Since, the objective of the study is to understand the potential role of AfT in helping countries to escape the MIT, the study first applied a hierarchical multiple regression. With this approach, variables or sets of variables are entered into the model in steps (or blocks), with each independent variable being assessed in terms of what it adds to the prediction of the dependent variable after the previous variables have been controlled for (Pallant, 2011). The contribution of the additional variables to explaining changes in the dependent variable is measured by the R^2 change. Based on existing MIT literature and economic growth theory, the study sought to investigate the unique contributions of the 3 components of AfT to economic growth when other determinants of economic growth are controlled for. Therefore, the hierarchical multiple regression was estimated using two models. The variables used to estimate the models are depicted in Figure 3. The analysis was also disaggregated by upper and lower middle-income groups in order to determine whether the impacts were different for the respective groups.

Figure 3 Hierarchical regression models



Source: Author's construct

Dynamic panel regression model

In addition to understanding the unique contribution of the AfT components to economic growth, the study also sought to understand the short and long term impacts of the AfT components on economic growth. This required the use of a dynamic panel regression model in order to address the issue of autocorrelation that was found. The dynamic linear panel regression model can be represented as follows (in notation based on Arellano (2003):

$$y_{it} = \alpha y_{i,t-i} + \beta' x_{it} + \eta_i + v_{it} \quad (1)$$

Where $\boldsymbol{y}$ is the dependent variable, $\boldsymbol{x}$ represents the explanatory variables. $\boldsymbol{\alpha}$ is the coefficient of the lags of the dependent variable. β' is the coefficient for time independent variables (LnAfPR, LnAfBPC, LnAfEI); η_i is the cross-section effect; and v_{it} *is* the white noise or error term. When explanatory variables are also lagged as was desired in our study, Arellano's equation can be represented as follows:

$$y_{it} = \alpha y_{i,t-i} + \beta_0 + \beta_1 x_{it} + \beta_2 x_{i,t-1} + \eta_i + v_{it} \quad (2)$$

In order to address autocorrelation in the model, the first lag of the dependent was used as an instrument. Before running this model, the Augmented Dickey-Fuller (ADF) unit root test was also conducted. All the variables were significant at level and 1st difference. Equation 2 was estimated using 3 separate 2-step dynamic panel regression where LnGDP, lnGDP per capita, and LnGNI per capita where the respective 3 dependent variables; however, the model with the GNI per capita did not meet the assumptions of the Sargan over-identification test. To overcome this, quantile regression was used.

Quantile regression

In order to address the issues of heteroskedasticy, autocorrelation, non-normality, and outliers, the panel quantile regression model was used. Quantile regression permits a more complete description of the conditional distribution than conditional mean

analysis alone since the model allows the population to be divided into segments with equal proportions of the reference population in each segment (Koenker, 2001; IHS Global Inc, 2017). The quantile regression can be represented as follows:

$$y_i = x_i{}'\beta_q + e_i \quad (3)$$

Where β_q is the vector of unknown parameters associated with the q^{th} quantile. Quantile regression offers a robust method of modelling relationships since it does not require strong distributional assumptions such as linearity, homoscedasticity, and normality, which are perquisites for regression models based on the conditional mean. The quantile regression is also able to handle outliers in the dependent variables. It should be noted that each of the 3 regression approaches were used to answer different aspects of the research question, which is why different variables were included in the respective estimates. The results for the various analyses are discussed in the next section.

4. Key findings and discussions

4.1. Distribution of Aid for Trade components

A descriptive analysis of the distribution of the 3 components of AfT components for the 73 middle-income countries in this study revealed that the LMI group of countries received more of each component than the UMI group of countries.

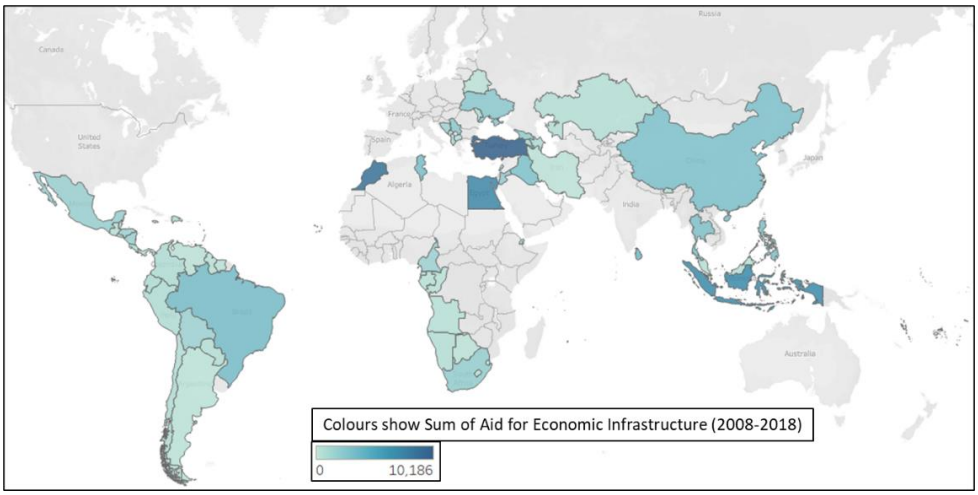
Table 2 Distribution of Aid for Trade components by income groups 2008–2018

Income Group		**AfEI**	**AfBPC**	**AfPR**
LMI	N	308	308	308
	Mean	154.88	55.83	2.71
	Median	57.52	32.18	0.72
	Minimum	0.02	0.59	0.00
	Maximum	1,534.07	1,079.02	43.75
	Std. Deviation	231.14	88.82	4.88
	Std. Error of Mean	13.17	5.06	0.28
UMI	N	495	495	495
	Mean	79.15	37.56	3.74
	Median	16.10	16.51	0.51
	Minimum	0.00	0.00	0.00
	Maximum	1,532.29	577.89	247.16
	Std. Deviation	168.00	69.01	15.97
	Std. Error of Mean	7.55	3.10	0.72
All 73 Countries	N	803.00	803.00	803.00
	Mean	108.20	44.57	3.35
	Median	28.31	20.16	0.62
	Minimum	0.00	0.00	0.00
	Maximum	1,534.07	1,079.02	247.16
	Std. Deviation	197.97	77.67	12.90
	Std. Error of Mean	6.99	2.74	0.46

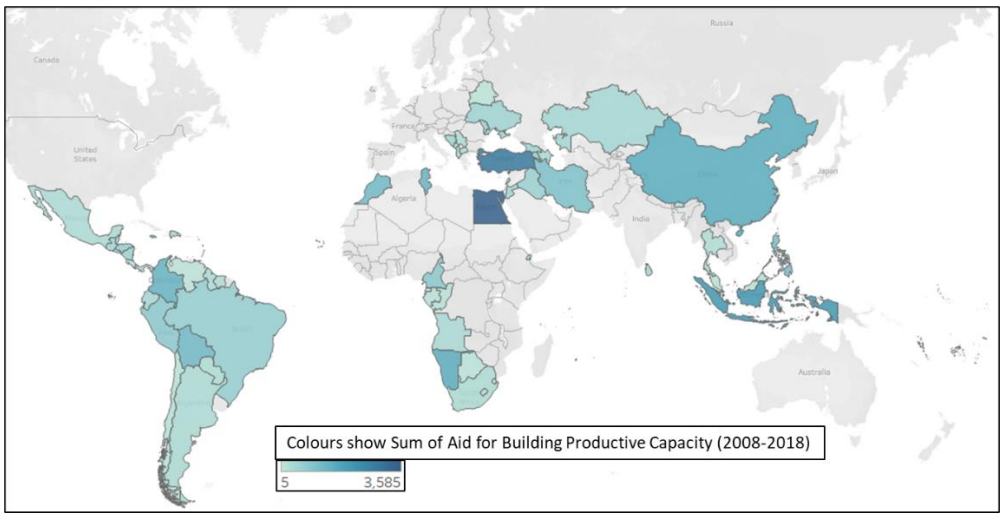
Source: Author's calculations

An analysis of the distribution of AfEI revealed that the top 5 recipients of this component of AfT were Turkey, Morocco, Egypt, Indonesia, and Sri Lanka (See Map 1). These countries were followed by Brazil, Tunisia, China, Iraq, and Thailand in that order.For the AfBPC, the top 10 recipients of this component of AfT were Egypt, Turkey, Indonesia, China, Namibia, Colombia, Tunisia, Bolivia, Morocco, Philippines (See Map 2).

Map 1 Distribution of Aid for Economic Infrastructure 2008–2018



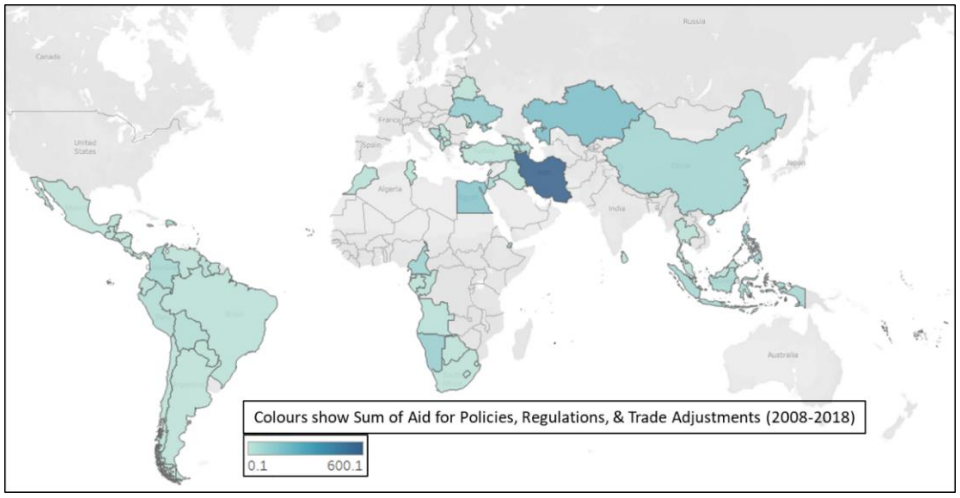
Map 2 Distribution of Aid for Building Productive Capacity 2008–2018



Source: Author's construct based on data from OECD

With regards to the Aid for Policies, Regulations, and Trade Adjustments, the study finds that Iran, Kazakhstan, Egypt, Grenada, Ukraine, Montenegro, St. Vincent and the Grenadines, Namibia, and the Philippines were the largest recipient of this AfT (see Map 3).

Map 3 Distribution of Aid for Policies, Regulations, and Trade Adjustments 2008–2018



Source: Author's construct based on data from OECD

4.2. Relationship between Aid for Trade components and economic growth

Before investigating the potential of the AfT components in helping middle-income countries to escape the MIT, the study used Pearsons product moment correlation (r) analysis to test if there was any significant relationship between the components of AfT and economic growth. This analysis done to provide a basis for the subsequent regression analyses.

Table 3 The components of AfT have a significant positive relationship with GDP

		LnGDP	**LnGDC**	**LnGNI**
LnAfPR	r	0.086*	-0.134**	-0.130**
	p-value	0.015	0	0
	N	803	803	803
LnAfEI	r	0.298**	-0.373**	-0.349**
	p-value	0	0	0
	N	803	803	803
LnAfBPC	r	0.283**	-0.255**	-0.256**
	p-value	0	0	0
	N	803	803	803

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Source: Author's calculations

The correlation analysis found a significant positive relationship between the AfT components and GDP, but the relationship between the components and per capita income was found to be negative although significant as well. This finding suggests that

for the sample countries as a whole, higher levels of AfT were associated with higher levels of economic growth but not per capita income. Due to endogeneity issues, the study compared the relationships between the AfT components and growth between the UMI and LMI countries. The study finds a significant positive relationship between the components and GDP in both countries; however, the relationship was stronger in countries classified as LMI. As indicated in Table 3, the Aid for Building Productive Capacity had the strongest relationship (r=0.8) followed by the Aid for Economic Infrastructure (r=0.6).

Table 3 Income groups influences relationship between AfT components and growth

		Lower Middle-Income			**Upper Middle-Income**		
		LnGDP	**LnGDC**	**LnGNI**	**LnGDP**	**LnGDC**	**LnGNI**
LnAfPR	r	0.189**	-0.056	-0.028	0.057	-0.165**	-0.169**
	p-value	0.001	0.33	0.626	0.204	0	0
	N	308	308	308	495	495	495
LnAfEI	r	0.563**	-0.046	-0.022	0.338**	-0.403**	-0.355**
	p-value	0	0.419	0.699	0	0	0
	N	308	308	308	495	495	495
LnAfBPC	r	0.790**	0.09	0.008	0.185**	-0.292**	-0.263**
	p-value	0	0.114	0.888	0	0	0
	N	308	308	308	495	495	495

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Source: Author's calculations

4.3. The potential of AfT components in escaping the middle-income trap

In order to determine the potential of the AfT components in helping countries to the escape the MIT the study investigated the impact of the AfT components on economic growth in the 73 countries after the various determinants of economic growth were controlled for using hierarchical multiple regression analysis. The study found a significant R^2 change between models 1 and 2 indicating that the components of AfT make a statistically significant unique contribution to economic growth in the middle-income countrie; however, the change was very minimal, not even up to 1% (Table 4).

Table 4 Results of hierarchical regression – Model Summary

Dependent variable	LnGDP		LnGDP per capita		LnGNI per capita	
Model	1	2	1	2	1	2
R	0.983a	0.984b	0.724a	0.799b	0.720a	0.793b
R^2	0.967	0.968	0.524	0.639	0.518	0.629
Adjusted R	0.967	0.967	0.517	0.633	0.512	0.622
R^2 change	-	0.000	-	0.115	-	0.111
Sig. F Change	-	0.019	-	0	-	0

a. Predictors: (Constant), Transport, Energy, ZFDI, Institution, ICT, Natural Capital,

Source: Author's calculations

An examination of the significance values of each of the independent variables indicates that only the Aid for Policies, Regulations, and Trade Adjustments (LnAfPR) had a significant impact on GDP when the other determinants of economic growth were controlled for, but its contribution was also very weak ($\beta = 0.022$). Similarly, the dynamic panel regression results show that only the LnAfPR and Aid for Building Productive Capacity had significant positive impacts on GDP but the impacts were not immediate. Only the previous year's AfT of these components had a significant impact on the current year's GDP.

Table 5 Results of 2-step dynamic panel, using 584 observations. Included 73 cross-sectional units. H-matrix as per Ox/DPD

Dependent variable LnGDP			Dependent variable LnGDP per capita		
	Coefficient	*p*-value		Coefficient	*p*-value
LnGDP(-1)	0.881945	<0.0001	LnGDC(-1)	0.912317	<0.0001***
const	0.00208478	0.3748	const	0.000353	0.8257
LnAfBPC	0.000859937	0.5716	LnAfBPC	0.000265	0.8413
LnAfBPC-1	0.00243704	0.0308**	LnAfBPC-1	0.001585	0.2073
LnAfBPC-2	0.00158957	0.47	LnAfBPC-2	0.001297	0.5651
LnAfPR	−4.60099e-05	0.7866	LnAfPR	0.000135	0.4642
LnAfPR-1	0.000282165	0.0861*	LnAfPR-1	0.000389	0.0698*
LnAfPR-2	−5.42381e-05	0.7351	LnAfPR-2	−0.000115766	0.5275
LnAfEI	−0.000463885	0.6256	LnAfEI	−6.02884e-05	0.9488
LnAfEI-1	−0.000720625	0.6495	LnAfEI-1	−0.000507571	0.7193
LnAfEI-2	−0.000465123	0.561	LnAfEI-2	−0.000526476	0.5023
Test for AR(1) errors: [0.0078]			Test for AR(1) errors: z = [0.0067]		
Test for AR(2) errors: [0.6683]			Test for AR(2) errors: [0.6901]		
Sargan test: = 38.462 [0.6683]			Sargan test: 43.5763 [0.4468]		
Pesaran CD test - *p*-value = 0.0569231			Pesaran CD test: *p*-value = 0.0506166		

**significant at 5%; *significant at 10%

Source: Author's calculations

Finally, the study sought to determine whether the growth level of countries determined the impact of the AfT components. The quantile regression estimates revealed that, in all quantiles, the AfBPC and AfEI had positive impacts; however, the AfPR only had positive impacts on GDP in the 80th and 90th quantiles. Generally, the impact of the various components of AfT had the greatest impacts in the lower quantiles (see Table 6 and Figure 4).

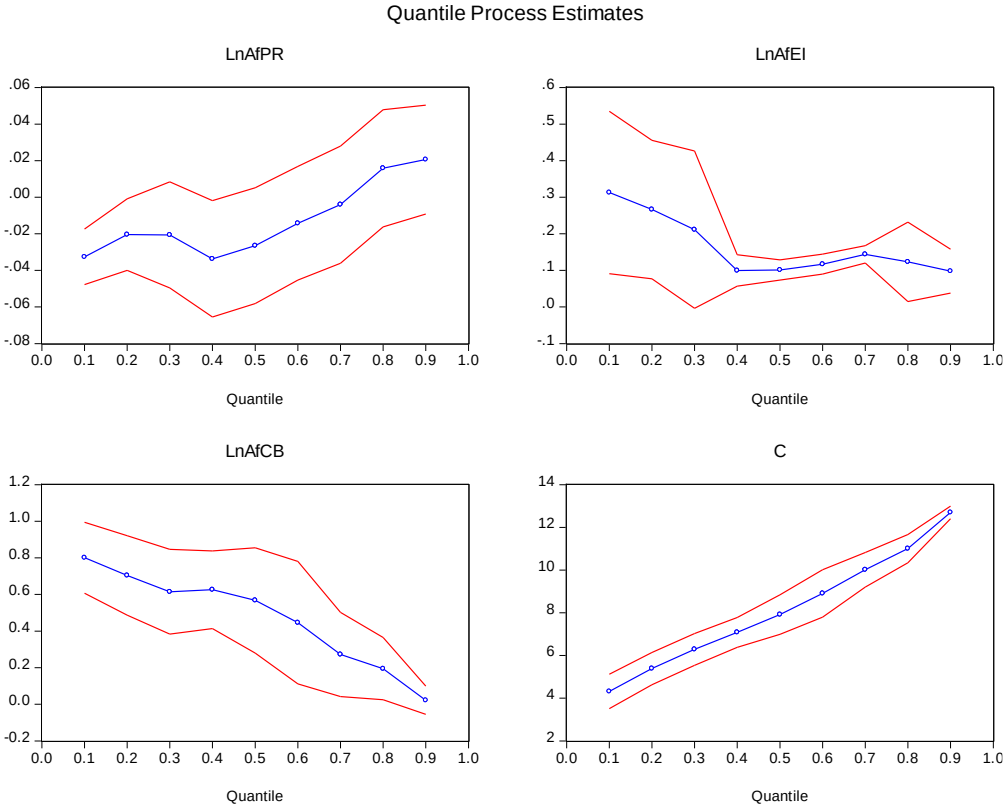
Table 6 Results of Quantile Regression

Quantile Process Estimates
Equation: UNTITLED
Specification: LNGDP LNPR LNTI LNCB C
Estimated equation quantile tau = 0.5
Number of process quantiles: 10
Display all coefficients

	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
LnAfPR	0.100	-0.032588	0.007722	-4.219968	0.0000
	0.200	-0.020412	0.009959	-2.049631	0.0407
	0.300	-0.020592	0.014782	-1.393042	0.1640
	0.400	-0.033706	0.016231	-2.076621	0.0382
	0.500	-0.026458	0.016138	-1.639455	0.1015
	0.600	-0.014215	0.015833	-0.897849	0.3695
	0.700	-0.004041	0.016346	-0.247196	0.8048
	0.800	0.015864	0.016340	0.970869	0.3319
	0.900	0.020603	0.015191	1.356310	0.1754
LnAfEI	0.100	0.312905	0.113205	2.764053	0.0058
	0.200	0.266361	0.096599	2.757402	0.0060
	0.300	0.211296	0.109650	1.927012	0.0543
	0.400	0.099731	0.021923	4.549132	0.0000
	0.500	0.101251	0.014027	7.218448	0.0000
	0.600	0.117116	0.013901	8.424908	0.0000
	0.700	0.144037	0.012135	11.86944	0.0000
	0.800	0.123571	0.055375	2.231529	0.0259
	0.900	0.097992	0.030659	3.196195	0.0014
LnAfBPC	0.100	0.800925	0.098883	8.099764	0.0000
	0.200	0.703942	0.110526	6.369040	0.0000
	0.300	0.614821	0.118247	5.199450	0.0000
	0.400	0.626167	0.108192	5.787539	0.0000
	0.500	0.567731	0.146807	3.867181	0.0001
	0.600	0.446198	0.170810	2.612239	0.0092
	0.700	0.271864	0.117280	2.318075	0.0207
	0.800	0.194957	0.086764	2.246982	0.0249
	0.900	0.022234	0.039393	0.564410	0.5726

Source: Author's calculations

Figure 4 Results of Quantile Regression



Source: Author's calculations

5. Conclusion

The study has investigated the potential of the 3 components of AfT in helping middle-income countries to escape the MIT. To address this objective, the study has analysed data for 73 middle-income AfT recipients from 2008 to 2018 using 3 different multiple regression approaches, namely, hierarchical multiple regression, dynamic panel regression, and quantile regression models. The study sought to answer 2 main research questions: (1) Do the components of AfT make unique significant contributions to growth in middle-income countries when other determinants of growth are controlled for? (2) Which of the 3 components of AfT has the greatest impact on economic growth in middle-income countries? The study has found that the components of AfT have a significant impact on growth in middle-income countries but impact varied across countries. For instance, the study has found that AfBPC (r=0.8) and AfEI (r=0.6) had a significant and strong positive relationship with GDP in the LMI countries, but the relationships were weak in the UMI countries, r=0.2 and r=0.3, respectively. When other determinants of growth such as productive capacity indicators, exports, and FDI were controlled for, the results of the hierarchical multiple regression have shown that only Aid for Policies, Regulations, and Adjustments had the greatest positive impact on

GDP, but the impact was very weak. This finding was confirmed by a dynamic panel regression. On the other hand, the results of the quantile regression analysis showed that, whereas the impact of AfPR on growth was negative in all quantiles except for the 80th and 90th, the impact was positive in all quantiles for both the AfBPC and AfEI. Furthermore, the impacts were more positive and stronger in countries with lower GDP. Since, the components of AfT have positive impacts on growth in the middle-income countries, it can be concluded that the AfT can contribute to countries escaping the MIT. However, this study has shown that the impact of AfT on growth is asymmetrical across countries in different income groups. Furthermore, other variables such as exports, FDI and productive capacity of countries and more significant impacts on economic growth. Therefore, AfT cannot be relied upon as a major driver of economic growth and escaping the MIT although AfT can make a significant contribution in some countries. Further in-depth country case studies and comparative studies would, however, be required to understand the unique country characteristics that accounts for the impacts of AfT in various countries as well as the asymmetrical impacts of AfT in beneficiary countries respectively.

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Appendix 1: List of 83 Aid for Trade recipients in 2006

LMI countries	UMI countries
1. Albania	1. Argentina
2. Angola	2. Belize
3. Armenia	3. Botswana
4. Azerbaijan	4. Brazil
5. Belarus	5. Chile
6. Bhutan	6. Costa Rica
7. Bolivia	**7. Croatia***
8. Bosnia and Herzegovina	8. Dominica
9. Cameroon	9. Equatorial Guinea
10. Cape Verde	10. Gabon
11. China	11. Grenada
12. Colombia	12. Kazakhstan
13. Congo, Rep.	13. Lebanon
14. Cuba*	**14. Libya***
15. Djibouti	15. Malaysia
16. Dominican Republic	16. Mauritius
17. Ecuador	17. Mexico
18. Egypt, Arab Rep.	18. Montenegro
19. El Salvador	**19. Northern Mariana Islands***
20. Fiji	**20. Palau***
21. Georgia	21. Panama
22. Guatemala	22. Serbia
23. Guyana	23. Seychelles
24. Honduras	24. South Africa
25. Indonesia	25. St. Kitts and Nevis
26. Iran, Islamic Rep.	26. St. Lucia
27. Iraq	27. St. Vincent and the Grenadines
28. Jamaica	28. Turkey
29. Jordan	29. Venezuela
30. Kiribati	**30. West Bank and Gaza Strip***
31. Lesotho	
32. Maldives	
33. Marshall Islands*	
34. Micronesia, Fed. Sts.*	
35. Moldova	
36. Morocco	
37. Namibia	
38. Nicaragua	
39. North Macedonia	
40. Paraguay	
41. Peru	
42. Philippines	
43. Samoa	
44. Sri Lanka	
45. Suriname	Note: * Countries were omitted from the study due to inadequate data.
46. Swaziland	
47. Syrian Arab Republic*	
48. Thailand	
49. Tonga	
50. Tunisia	
51. Turkmenistan*	
52. Ukraine	
53. Vanuatu	

Appendix 2: Results of hierarchical multiple regression

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.615	.266		6.078	.000					
	LnEx	.903	.012	.874	77.993	.000	.979	.942	.511	.342	2.925
	ZFDI	.143	.021	.063	6.841	.000	.533	.240	.045	.506	1.977
	Human Capital	.034	.004	.089	7.648	.000	.308	.266	.050	.320	3.126
	ICT	-.037	.007	-.054	-5.298	.000	.191	-.188	-.035	.413	2.422
	Structural Change	.013	.007	.020	1.818	.069	.516	.066	.012	.340	2.942
	Institution	-.006	.002	-.032	-3.623	.000	-.320	-.130	-.024	.540	1.851
	Natural Capital	-.006	.002	-.022	-2.675	.008	.273	-.096	-.018	.641	1.561
	Private Sector	-.005	.003	-.015	-1.487	.137	-.032	-.054	-.010	.408	2.451
	Energy	.010	.004	.018	2.356	.019	.271	.085	.015	.704	1.421
	Transport	-.028	.003	-.083	-9.054	.000	-.497	-.311	-.059	.512	1.953
2	(Constant)	1.680	.270		6.224	.000					
	LnEx	.904	.012	.874	77.745	.000	.979	.942	.507	.336	2.976
	ZFDI	.134	.021	.059	6.321	.000	.533	.223	.041	.492	2.033
	Human Capital	.031	.005	.082	6.883	.000	.308	.242	.045	.302	3.310
	ICT	-.032	.007	-.046	-4.410	.000	.191	-.158	-.029	.383	2.613
	Structural Change	.017	.007	.026	2.306	.021	.516	.083	.015	.329	3.041
	Institution	-.006	.002	-.032	-3.623	.000	-.320	-.130	-.024	.538	1.858
	Natural Capital	-.006	.002	-.022	-2.684	.007	.273	-.097	-.018	.628	1.593
	Private Sector	-.005	.003	-.016	-1.598	.110	-.032	-.058	-.010	.404	2.478
	Energy	.008	.004	.016	2.009	.045	.271	.073	.013	.687	1.455
	Transport	-.027	.003	-.079	-8.555	.000	-.497	-.296	-.056	.498	2.009
	LnPR	.007	.002	.022	3.001	.003	.086	.108	.020	.779	1.284
	LnTI	.003	.004	.006	.794	.427	.298	.029	.005	.699	1.431
	LnCB	-.006	.009	-.005	-.668	.504	.283	-.024	-.004	.653	1.532

a. Dependent Variable: LnGDP

Appendix 3: Unit root test results

Unit Root Test

Null Hypothesis: HUMAN_CAPITAL has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.490903	0.0000
Test critical values:	1% level	-3.438638	
	5% level	-2.865088	
	10% level	-2.568715	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: INSTITUTION has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.315335	0.0000
Test critical values:	1% level	-3.438638	
	5% level	-2.865088	
	10% level	-2.568715	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: PRODUCTIVE_INDEX has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.141780	0.0000
Test critical values:	1% level	-3.438454	
	5% level	-2.865007	
	10% level	-2.568671	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: ICT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.586594	0.0000

Test critical values:	1% level	-3.438402
	5% level	-2.864984
	10% level	-2.568659

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: STRUCTURAL_CHANGE has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.869246	0.0000
Test critical values:	1% level	-3.438638	
	5% level	-2.865088	
	10% level	-2.568715	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: LNCB has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.507085	0.0000
Test critical values:	1% level	-3.438299	
	5% level	-2.864938	
	10% level	-2.568634	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: LNEX has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.778344	0.0001
Test critical values:	1% level	-3.439867	
	5% level	-2.865630	
	10% level	-2.569005	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: LNGNI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-7.375849	0.0000
Test critical values:	1% level	-3.438278	
	5% level	-2.864929	
	10% level	-2.568629	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: LNTI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.92060	0.0000
Test critical values:	1% level	-3.438288	
	5% level	-2.864934	
	10% level	-2.568632	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: LNPR has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.10893	0.0000
Test critical values:	1% level	-3.438288	
	5% level	-2.864934	
	10% level	-2.568632	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: LNGDP has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.207240	0.0000
Test critical values:	1% level	-3.438391	
	5% level	-2.864979	
	10% level	-2.568656	

*MacKinnon (1996) one-sided *p*-values.

Null Hypothesis: LNGDC has a unit root

Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=20)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.789210	0.0000
Test critical values:	1% level	-3.438391	
	5% level	-2.864979	
	10% level	-2.568656	

*MacKinnon (1996) one-sided *p*-values.

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The impact of the demographic transition on poverty reduction in Central Asia

Muyassar Kurbanova

Central Asian countries are experiencing a demographic transition due to the shrinking fertility and mortality rates and are at the stage of getting benefits from the demographic tailwinds with an increased working-age population share. This potential may convert the transition into economic growth and poverty reduction. Although all countries' economies grow, poverty reduction stagnated. The main question is whether this stagnation is due to an increase in the working-age population and whether the region can utilize this benefit to reduce poverty through accumulating human recourses. This paper analyzes the main channels that impact demographic change with the human capital in the socio-economic situation and the poverty rate of Central Asian countries by using cross-section data from the period 2000 to 2019 using the fixed effects method. The results suggest that the share of working-age population, human capital, GDP per capita, and female labor force participation rate will reduce poverty in the region.

Keywords: Demographic dividend, Central Asia, poverty, economic growth, demographic transition

1. Introduction

Over the past five decades, most of the countries of the world have been experiencing a great demographic transition due to the shrinking fertility and mortality rates, which creates negative or positive effects on the economies. Developed countries are facing an aging problem while less developing countries are at a stage of benefiting from the demographic tailwinds with an increased working-age (15–64 years old) population share. The process of an increasing share of the active population offering a window of opportunity alludes to the demographic dividend. The duration of the demographic window is defined when the share of children (aged 0–14) falls below 30% and the population aged 65 and over is still below 15% (United Nations 2004). With the favorable age structure, economic growth can be increased, however, this bonus is only transitory and requires setting various economic preconditions (Mason 2001, 2005, Mason–Lee 2007), such as an investment in human capital and an effective policy framework. Hence, human capital is considered as a trigger of economic growth, demographic change (Lutz et al. 2019), the source of higher income (Lee–Lee 2013, Issa 2005, Arabi and Abdalla 2013), and poverty reduction (Osotimehin and Director 2017). In several studies, it is suggested that human capital investment improves education and the health care system (Lee–Lee, 2013, Duflo et al. 2015, Ashraf et al. 2008).

A change in the age structure of the population without proper human capital investment and policy implications provides socio-economic challenges (Bloom–

Williamson 1998, Pool 2004, Pool et al. 2006, Gomez and deCos 2008, Navaneetham–Dharmalingam 2012). Therefore, understanding demographic challenges should be a priority. One of the main challenges in a condition of increasing labor force following with the lack of job opportunities may cause to increase poverty and inequality in society. The inequality could be observed in a country at a stage of demographic transition while having different economic lifecycle schedules among various age groups (de la Croix–Doepke 2003, DeGraffet et al. 1996; Orbeta, 2006). Hence, for people living under the poverty line, it is difficult to get loans from formal lending centers for investing in their education and health, moreover, parents' illiteracy makes it harder for their children to study in a better environment (Banerjee–Duflo 2007, Khitakhunov 2020). This condition makes it difficult to harness the demographic dividend (Abrigo et al. 2016).

Like several developing countries, the Central Asian region (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) has been experiencing a declining fertility rate over the last several decades from 5.32 in 1960 to 2.75 in 2020 (Worldometers 2021), which follows decreasing mortality and improving longevity. In line with changes in fertility, the age structure has also changed. The share of the working-age population is increasing, while the young population aged 0-14 has decreased. On the other hand, the share of the older generation is slightly growing, more rapidly in Kazakhstan and more slowly in Tajikistan. Despite changes in the population age structure, Central Asian countries continue to be among the demographically young countries with a median age of the population at 27.6 years in 2020 (Worldometers 2021).

Despite having a similar demographic background of economic growth, these countries differ from each other in the level of socio-economic development. Especially after the break-up of the Soviet Union in 1991, the Central Asian countries chose quite different economic development paths, as a result of which their degree of success now varies. Kazakhstan has the largest area and the least population density, accounting for approximately 51% of the total regional GDP, most of which the country receives from oil. Uzbekistan has the largest population, accounting for 45% of the total population of the region. Kyrgyzstan and Turkmenistan have almost the same population size. But Turkmenistan is a desert country with large energy reserves, especially natural gas, which accounts for 16% of regional GDP. And Kyrgyzstan is a small mountainous country with few natural resources, except water, hydropower, and some gold, which account for 5% of regional GDP. Tajikistan is similar to Kyrgyzstan in terms of resources and size, but even poorer and more isolated (Aytmagambetova 2009).

As a result of variable economic development in the region, income inequality and the poverty gap have increased in Central Asia, especially after the collapse of the Soviet Union and when starting to transform from a centrally planned to a market-oriented economy (Heller and Keller 2001, Bandara et al. 2004, Jha and Dang, 2009). It is noteworthy to mention that a decade ago one-third of the population was living in absolute poverty, and a noticeable rate of extreme poverty still exists (Hayes 2014). Although due to rapid economic growth the majority of the population was lifted out of poverty in Central Asia, however, some of the region's countries are still struggling to catch up (Seitz 2019, Khitakhunov 2020). Of the Central Asian countries, only Kazakhstan has achieved a large reduction in poverty after independence, and its

extreme poverty rate is almost zero, however, the country is vulnerable to economic shocks as it depends on commodity prices and international organizations' loans that could contribute to poverty reduction.

The region's countries are not just blessed with natural resources but also have a favored population age structure in which the working-age population is increasing continuously. However, this process may worsen the structural weakness of some counties, mainly Kyrgyzstan and Tajikistan, where the unemployment rate is high following the highest level of poverty. This will give a rise to new waves of migration, and largely unskilled migrants could accompany a destabilized job market and create social tensions (Jha–Dang 2009). Ultimately, in this paper I am interested in whether the poverty in the region may increase or decrease in the case of changing in age structure. This implies that more research is needed to estimate the effect of the demographic transition on economic growth and poverty reduction focusing on Central Asia, as human poverty remains a major issue of developing countries.

The objective of this paper is to analyze the link between poverty and change in the age structure with human capital development along with other indicators in all Central Asian post-communist countries. And through analyses, it intends to investigate the challenges and identify the demographic window of opportunity and adapt these to provide the direction of policy implications for capitalizing on the demographic dividend and reduce poverty.

The research addresses the following empirical research question:

- What is the relationship between poverty, demographic transition, and other human development indicators in the case of post-communist Central Asian countries?

By addressing the research question my analysis is performed with the fixed effect (FE) method for analyzing the link between poverty and demographic, socio-economic indicators in the period of 2000 to 2019. This method allows to get precise unbiased estimates (Collischon–Eberl, 2020). To my knowledge, the FE method has not been used for analyzing the relationship of poverty, demographic transition, and human development dimensions regarding the Central-Asian countries. In the light of poverty measurement, this paper uses instruments that directly and indirectly affect the education standards, demographic variables, and living standards of the people.

The paper is organized as follows. Section 2 provides a brief literature review, followed by an outline of the economic and demographic condition of the Central Asian countries in section 3. Section 4 explains the methodology and data source. The empirical results are discussed in section 5. The final section presents the conclusion and recommendations for policy implication.

2. Literature review

Demographic transition consists of three stages based on the level of fertility and mortality rates. The initial stage begins with high fertility and mortality rates, while the second stage follows with high fertility but low mortality, and the last one with low fertility and mortality rates. These changes can affect economic growth through an

inverted U-shaped relationship known as a demographic U-hypothesis. The initial two stages may contribute positively to economic growth as labor supply and savings increase continuously in a so-called window of opportunity, however, the last stage leads to an aging society through less labor supply and decreasing savings rate (Mehmood et al. 2012). In some sources the relation between fertility and economic growth subsumes an algebraic relationship of a quadratic function, which means that initially the effect of fertility reduction encourages economic growth, but later it reduces it (Cai 2010). So far, most studies have focused on the effect of demographic change on economic growth (Bloom–Canning 2003, Bloom et al. 2000, Bloom et al. 2003, Bloom–Freeman 1988, Bloom–Williamson 1998, Brander and Dowrick 1994, Kelley–Schmidt 1995), known as a demographic dividend, which is characterized as a first and second demographic dividend (Lee–Mason 2006).

The first demographic dividend is a transitory bonus and occurs directly as the result of the increasing working-age population such that effective producers rise more than the effective consumers (Abio et al. 2017). The second demographic dividend converts this bonus into economic growth through effective demographic and economic policies. This period will occur while increasing the savings of the population, investing in human capital, and capital per worker continues to be at a higher level (Abio et al. 2017, Baerlocher et al. 2019) in the long run. Undoubtedly, maximizing human capital enlarges the productivity assets of nations (Young 2019), and enables the labor force to be flexible and innovative (World Bank 2018, Cummins 2019). Later on, if the second demographic dividend is not managed efficiently, and the number of the working-age population starts to decrease, the aging problem occurs in the country and the economic gains will be diminished (Lee–Mason 2009).

In addition to the positive effect of the demographic transition on economic growth, there is evidence that this process will impact inequality and poverty, although the studies about it are relatively smaller scale (Ahmed et al. 2014, Mason–Lee 2004, Ahmed et al. 2016). There are mechanisms by which the demographic transition will lead to poverty alleviation. The initial process suggests that there is a direct link between shaping poverty attribution and macroeconomic indicators (Burgoyne et al. 1999, Gallie and Paugam 2002), especially the demographic dividend will boost economic growth and reduce poverty (Dollar et al. 2015, Dollar–Kraay 2002, Kua–Piyachart 2016). However, as a result of the reduction of non-earning members, the consumption per capita of the household decrease and will cause a lower poverty rate (Cruz–Ahmed 2018). The next steps are related to the second demographic dividend, that demographic transition in a dimension of education reduces poverty especially, in a condition of lower fertility rate families invest more on children's education (Kua–Piyachart 2016) and when females become more educated and start having fewer children, they will be active in a job market (Bloom et al. 2009, Klepinger et al. 1999), which leads to an increase in income-earners in the household and in the living standards. Moreover, increasing the number of workers will contribute more to the economy, and the government will devote additional recourse to low-income families (Cruz–Ahmed 2018). Similarly, as an investment in human capital for the upcoming young generation increases, their lifetime earning potential will rise subsequently (Rosenzweig–Schultz 1987, Schultz, 2007), in which especially education plays a significant role (Ahmed et al. 2016). It is noteworthy to mention that in a condition of the demographic shift, economic growth

and poverty reduction are policy depended. Efforts need to be made in the development of health care and education (Falkingham 2005).

In contrast, the higher vulnerability to poverty will appear in a condition of the larger dependency ratio (Jha–Dang 2009), as there is a positive relationship between poverty and household size (Merrick 2002). Barros et al. (2015) estimated that demographic change brought an additional 0.4–0.5% in annual growth in per capita income, followed by a reduction of poverty in Brazil. In addition, poverty decreased from 61 percent to 7.2 percent between 1990 and 2012 in East Asia, associated with a sharp fall in the child dependency ratio (World Bank 2020).

From a regional perspective, evidence from Central Asia demonstrates that these countries are still challenged by poverty (Jha and Dang 2009). During Soviet times income inequality was limited with the help of a high level of social expenditure and low wage differentials (Atkinson and Micklewright 1992). However, after the collapse of the Soviet Union and transition from centrally planned to market economies poverty increased and changed its nature (Alam et al. 2005, Klugman et al. 2002, Milanovic–Ersado 2012, Habibov 2011, Habibov–Fan 2007, Klugman 1997) showing that in the Soviet era only selected categories like single mothers, disabled and old-age pensioners were vulnerable to poverty, which changed after independence in post-communist countries (Habibov et al. 2017). Moreover, throughout Central Asia, a higher poverty rate is observed in the more densely populated areas of the region's countries (Seitz 2019).

Several researchers have studied poverty, its factors, and its vulnerability in the context of Central Asia. Seitz (2019) found out that labor migrants contribute significantly to the poorest areas through remittances and investment, according to their survey, about 19 percent of families have at least one migrant abroad in Central Asia. Another channel for reducing the poverty was analyzed by Falkingham (2004), mentioning that priority should be given to the youth education system and provide the labor market with the required skills. Moreover, effective governance, especially strengthening the public administration system and involving the community in the decision-making process provide guarantees to improve the material and capability aspects of poverty (Falkingham 2005). Besides, an increase in GDP significantly reduces the structural attribution of poverty in Central Asia (Habibov et al. 2017). In essence, previous studies have focused on poverty on the individual and country level, its factors, and influence direction within Central Asia. The literature review demonstrated that no previous studies have emphasized the effect of change on age structure in poverty, estimating it through empirical analyses. Examining this effect allows us to set the right policy in a condition of increasing the working-age population.

3. Economic development, demographic transition and poverty in Central Asia

Central Asia is a very heterogeneous region in terms of socio-economic processes. It is rapidly fragmenting in terms of living standards, rates of economic growth, quality of social services, and access to infrastructure. Especially, the gap in the development of the Central Asian countries at the present stage is increasing from year to year. Moreover, the urbanization of the countries so extremely unbalanced that in Kazakhstan a significant part of the population is city residents, while Kyrgyzstan and Tajikistan rural communities dominate (see Table 1).

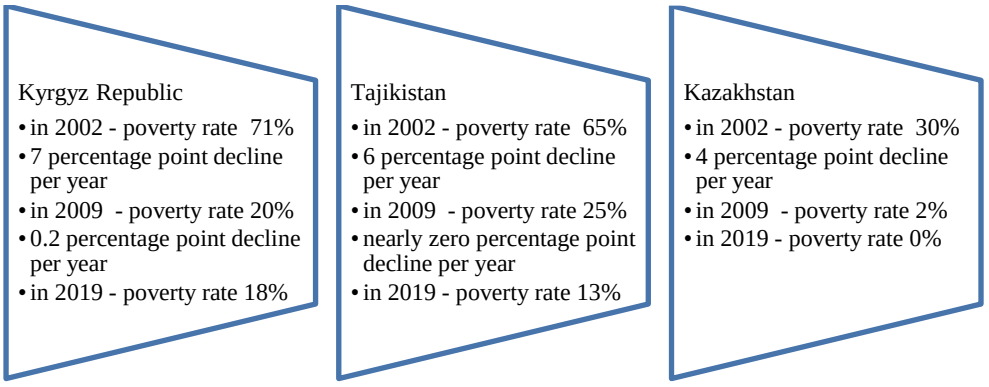
Table 1 Social-economic development indicators of Central Asian countries

Countries	1995	2000	2005	2010	2015	2018
			GDP per capita (constant 2010 US$)			
Kazakhstan	3,738.469	4,491.592	7,227.983	9,070.488	10,617.47	11,165.54
Kyrgyzstan	534.9587	654.312	747.5656	880.0378	1,021.161	1,090.868
Tajikistan	447.1117	415.4645	603.2518	749.5527	935.9998	1,073.022
Turkmenistan	2,054.282	2,381.175	2,899.957	4,439.2	6,693.932	7,647.936
Uzbekistan	876.4232	979.012	1,196.422	1,634.312	2,138.567	2,373.538
			Urban population (% of total population)			
Kazakhstan	55.921	56.098	56.463	56.827	57.191	57.428
Kyrgyzstan	36.349	35.298	35.29	35.306	35.777	36.351
Tajikistan	28.877	26.501	26.51	26.52	26.742	27.134
Turkmenistan	44.794	45.913	47.052	48.491	50.317	51.593
Uzbekistan	43.731	46.126	48.537	50.956	50.75	50.478

Source: World development indicators, 2020

The nature of poverty is also varied within the region. According to the data of the World Bank, the poverty rate in the region continues to decline overall, however, the pace of poverty reduction is slowing. Especially, a high level of poverty remains in remote and rural areas due to lack of employment opportunities and a close integration with urban growth centers (World Bank, 2020). In remote areas of Tajikistan and the Kyrgyz Republic, the poverty rate is above 40%. Although due to initiated macroeconomic reforms and anti-inflation policies the incidence of poverty decreased, especially in Kazakhstan (Jha and Dang 2009), however, for the rest of Central Asian countries this problem remains (see Figure 1).

Figure 1 Poverty reduction rates in Central Asian countries ($3.2 per day)



Source: World Bank, 2020

The poverty reduction rate was significant until 2009, with an average 7 percentage point decline annually from 2002 to 2009, both in the Kyrgyz Republic and Tajikistan. However, after that period the rate of poverty reduction has fallen more slowly. Among Central Asian countries only Kazakhstan could eliminate poverty, which is measured by 3.20$ income per day. Due to the unavailability of lower-middle-income country poverty line data for the rest of Central Asian countries (3.20$ income per day), we try to analyze the poverty situation in these countries relying on the employed persons living in poverty indicator, also known as the working poor. This indicator allows identifying the share of the employed population living in poverty, where despite having a job, their income is not sufficient to ensure the basic living expenses. Surprisingly, the difference between the poverty rate and the working poverty rate is not significant (Gammarano 2019).

According to the poverty rate, the situation in Uzbekistan and Turkmenistan is also not favorable like in other Central Asian countries. The share of extremely poor was 20% in 2019 in Uzbekistan, meaning that despite being employed, one-fifth of all workers lived in extreme poverty. In Turkmenistan, the situation is much better (Table 2).

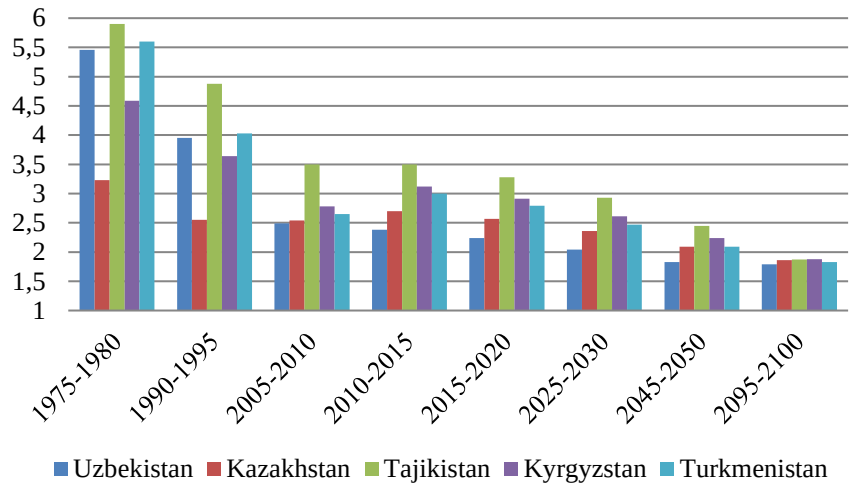
Table 2 Share of employment by economic class (%, ILO modeled estimates, 2019)

Country	**Extremely poor**	**Moderately poor**	**Near poor**
Kazakhstan	0	0	4
Kyrgyzstan	0	13	45
Tajikistan	4	12	30
Turkmenistan	8	7	12
Uzbekistan	20	18	26

*Extremely poor: less than $1.90 a day, moderately poor: $1.90 to $3.20 a day, near poor: $3.20-$5.50 a day (using 2011 PPPs)
Source: ILO modeled estimates, ILOSTAT

Poverty in most developing countries is associated with large families and high birth rates. However, the ongoing demographic shift accompanied by changing from large to smaller families provides evidence that poverty may reduce in Central Asia due to the demographic transition that is characterized by a decrease in fertility and an increase in life expectancy. Although an increase in the region's population had been observed over the last half-century, starting from recent years the growth slowed down, and in the middle of 21 century, it is expected to decrease, especially in Uzbekistan. One of the reasons for the population reduction is explained by a decline in the birth rate in all countries of the region since 1992 by at least 25%. The fertility rate is expected to further decline in all countries of the region (see Figure 2), and it is expected that more women will enter the labor market. Currently, the female labor force participation rate is still not at an adequate level, where the highest rate is observed in Kazakstan with 62% and the lowest rate is in Tajikistan with 31% among the region's countries. This situation can be explained through the countries' different fertility rates (World Bank 2020).

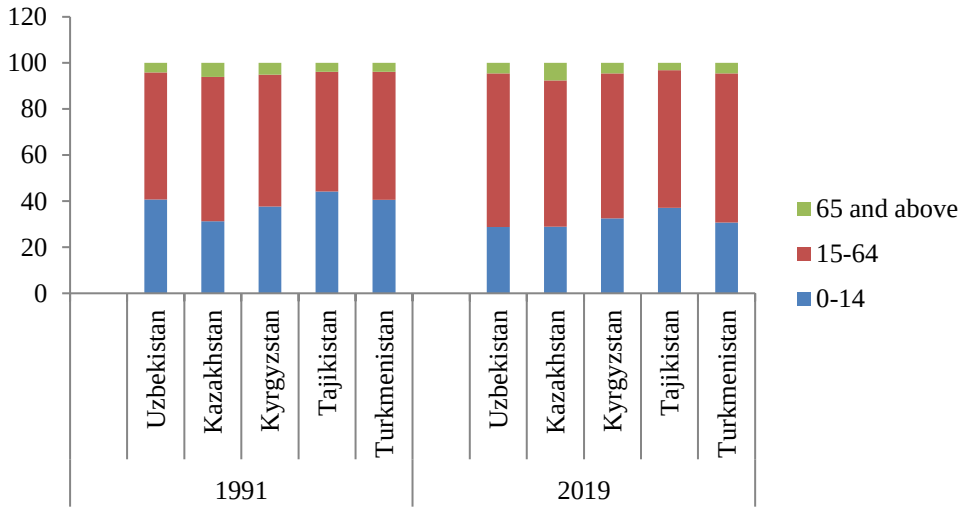
Figure 2 Total fertility, Central Asian countries, 1975–2100 (live births per woman)



Source: WPP, 2017

However, the region has a very favorable age distribution. About 30% are under the age of 14 and 10% are over the age of 65, while almost 60% are active population (15–64 years old) over the period (see figure 3).

Figure 3 Age distribution of Central Asian countries



Source: World development indicators, 2020

The demographic transition in the region enables a rise in economic opportunities as well as social and policy challenges, especially a shortage of qualified personnel and low quality of human capital. However, for all countries in the region, the problem of

employment of the population, primarily youth, remains extremely urgent. The demographic shift, with an enormous growth of young people in the labor force, creates heavy pressure on the region's job market. According to the official data, the highest youth unemployment is in Tajikistan at 11.3%, and the lowest is in Turkmenistan at 3.8%. At the same time, the countries of the region are experiencing an acute shortage of qualified specialists, which means that the level and the quality of human capital investment across Central Asia are very unlikely to reap the demographic dividend. One of the main reasons for this contradictory situation is the low level of education and limited access to higher education (see Table 3). Along with this, unemployment among young graduates is observed, which can be explained by the mismatch between skills demanded in the labor market and those offered by the labor force. These countries' educational systems are not producing the necessary skills for the graduates.

Table 3 Changes in education enrolment rates (% of the relevant age group), 1989–2018

	Pre-primary			General secondary (15-18 years)			Tertiary (19-24)		
	1989	2019	% change 1989-2019	1989	2019	% change 1989-2019	1989	2019	% change 1989-2019
Kazakhstan	53.1	62.2	117	32.5	99.8	307	18.1	61.7	340.8
Kyrgyzstan	31.3	38.9	124.2	36.7	85.2	232.1	13.2	42.3	320.4
Tajikistan	16.0	8.4*	52.5	40.4	98.3*	243.3	11.5	31.3*	272.1
Turkmenistan	33.5	n/a	n/a	41.7	89.6	214.8	10.2	14.2	139.2
Uzbekistan	36.8	31.9	86.6	36.3	93.5	257.7	15.0	12.6	84

*2017

Source: UNICEF Transmonee database, Falkingham (2005).

Moreover, the share of the working-age population with higher and secondary vocational education in Central Asia is significantly lower than in European countries. Unfortunately, national systems of vocational education cannot provide the economies of the countries of the region with the necessary number of specialists with a sufficient level of training.

4. Data and methodology

As is discussed above, increasing the share of the working-age population in Central Asian countries may reduce or increase poverty in the region. In order to see the effect of this change on the whole region, I adopt previous researchers' methodologies. Following the empirical exogeneous framework to estimate the effect of demographic transition with human capital and socio-economic indicators on poverty reduction in Central Asian countries, I adopted Cruz and Ahmed's (2018) methodology.

It is suggested that poverty analysis should be complemented with not only one indicator but with other socio-economic measures as this provides a wider picture of poverty and identifies the main causes behind it (Gammarano 2019). For this reason, I

conduct an equation to explain poverty through demographic, economic, and human capital variables. As I will estimate a region's countries overall, it is more effective to use the panel data estimation. This method has several advantages such as getting better estimates through a large sample, controlling for unobservable variables, accounting for heterogeneity, and tackling the omitted variables bias problem (Ahmad–Khan 2019). For panel data analysis it is common to use random effects and fixed effects models. However, Bloom et al. (2013) suggested that the existing endogeneity problems for human capital and demographic variables can be solved through the Two-Stage Least Squares method, but there are no instrumental variables for our case. Moreover, we cannot use the Ordinary Least Squares method as it will not tackle the omitted variable bias problem.

Based on the work of Cruz and Ahmed (2018), I estimated the following econometric model for the fixed effects method, where GDP per capita ($GDPPC_{it}$), working-age population ratio (WAP_{it}), female labor force participation rate (FL_{it}), mean years of schooling (X_{it}), total fertility rate (TFR_{it}) and the share of urban population (U_{it}) are key in determining poverty (P).

$$P_{it} = \beta_0 + \beta_1 GDPPC_{it} + \beta_2 WAP_{it} + \delta_3 FL_{it} + \beta_4 X_{it} + \delta_5 TFR_{it} + \delta_6 U_{it} \qquad (1)$$

In my analysis, I used poverty as a dependent variable. Two approaches of measuring poverty are used commonly in empirical analysis: direct and indirect. Income is considered as an indirect approach, which is most commonly traditionally used to measure poverty (Wongboonsin–Phiromswad 2016, Jha–Dang 2009). Traditionally, poverty is measured by the number of people living under the international poverty threshold. Indeed, internationally comparable estimates of poverty are provided by the World Bank, where the dollar-a-day line was $1.25 in 2005 and changed to $1.90 a day in 2011 (World bank 2020). Moreover, the international practice uses the income class poverty line, defined at $3.2 for lower-middle-income countries and $5.5 for upper-middle-income countries. On the other hand, the direct approach lies in the standard of living, such as having clean water or access to electricity. In this paper, I rely on an indirect approach, more specifically the working poverty rate, measured as the percentage of employed living below US$1.90 PPP.

Due to the lack of an absolute international poverty line (1.90$ per person daily) data for all Central Asian countries in the period between 2000 and 2019, I used the share of the employed who are poor as a proxy of poverty in my estimation. Employment aims to be a bridge to lift people out of poverty. This can be true only in a condition of adequate earning, sufficient job quality, and job security. One of the advantages of using the working poverty rate in our regression model is that this indicator provides valuable insights into the percentage of employed people living in poverty despite having a job, hinting that the employment-related incomes are not enough to secure better living conditions for themselves and their families and lift them out of poverty (Gammarano 2019). Moreover, it provides an opportunity to formulate effective policies.

For eradicating extreme poverty, it is essential to focus on its root causes. In this sense, I included the share of the population aged 15–64 and the total fertility rate in my model as they represent demographic transition indicators and allow us to identify whether there is a link between demographic dividend and poverty.

GDP per capita (in constant 2010 prices) data is also added as there is a direct effect of economic growth on poverty. To avoid getting biased results, data about the characteristics of the population living in poverty is necessary. A better education is considered as a trigger for lifting out of poverty (Barro–Sala-i-Martin 2004), in this sense, a mean years of education effect is observed as well. As discussed above, the poverty hotspot in Central Asia is more likely to be in rural areas that lack close integration with urban growth centers, for this reason, I added the proportion of people living in urban areas. The study utilized secondary data from the World Development Indicators (WDI), ILO database, and human development database spanning from 2000 to 2019 for five Central Asian countries, allowing an estimate panel data analysis. However, the limited availability of data on some variables did not allow for covering longer periods.

5. Results of the fixed effect method

In this paper, I applied the fixed effect method to get an efficient result. For choosing between random and fixed effects, I applied the Hausman Test and found that fixed effect estimation is more appropriate for my model. The empirical estimation of the model, which was expressed in equation one, is given in Table 4. To correct for heteroskedasticity error, I use robust estimators.

Table 4 Results of fixed effect estimation

Dependent variable: poverty (the percentage of employed living below US$1.90 PPP)	
Variable	Coefficients
C	177.324
	[112.17]
$GDPPC_{it}$ – GDP per capita	-4.079
	[.447]***
WAP_{it} - Share of working age population	-0.367
	[0.237]*
TFR_{it} – Fertility rate (total (births per woman))	7.788
	[14.576]
X_{it} - Mean year of schooling	-6.962
	[1.159]***
FL_{it} - Female labor force participation	-0.555
	[0.182]**
$g_{U_{it}}$ – the share of urban population	-0.670
	[1.986]
R-squared	0.2737

Robust standard errors are in parenthesis
Note: *, **, *** represents Significant level at 10%, 5% and 1%, respectively.

According to the results of my model, GDP per capita, the share of working-age population, female labor force participation and mean years of schooling show significant results and have a positive impact on the reduction of poverty. The percentage point of growth above-mentioned indicators provide an opportunity to

reduce poverty in Central Asia. The fertility rate has shown a positive influence on poverty, as the increasing of the total fertility rate is estimated to be associated to increase poverty, however, the coefficient is not significant (Table 4).

From the short review above, key findings emerge: the education effect, which is taken as a proxy for human capital, is higher than the age effect. This implies that education is a key mechanism for reducing poverty. Moreover, providing job opportunities for the female labor force and making them active in the labor market brings a positive outcome for the alleviation of poverty. In the case of Central Asia, the demographic transition can turn further advantages only by accumulating human capital effectively. In a nutshell, all control variables have an encouraging impact on poverty reduction. Hence the suggestion to make policy implications in this direction.

6. Conclusion

This paper has investigated the effect of demographic transition and human capital on poverty reduction in Central Asia. The empirical analysis has been estimated for 5 countries of the region applying a panel dataset for the period between 2000 and 2019. In order to examine the evidence for the inverse relationship between poverty and demographic transition with human capital, the fixed effect method was used.

The empirical results of my estimation indicate a significant and negative relationship between the share of the working-age population, GDP per capita, labor force participation rate, and the mean years of schooling. These variables might decrease poverty in the region.

However, the variables that represent human capital investment have shown a significant and positive impact. Especially the female labor force participation ratio is significant and reduces the poverty. Mean years of schooling and GDP per capita have a robust positive effect on economic growth as well, which is consistent with the theoretical suggestions. Similarly, the share of the urban population has shown a positive contribution, however, the coefficient is insignificant.

My empirical results confirm that the increasing working-age population correlates negatively with poverty, that ongoing demographic transition can provide an opportunity to reduce poverty in Central Asia. However, almost in the whole region, the main challenges are the lack of enough job supplies that enable to reduce unemployment, and the low education level is not appropriate for labor market demands.

An important policy implication based on my empirical results suggests that the demographic transition enables the countries to provide an opportunity to reduce poverty by effectively accumulating the capabilities of the working-age population. It can be done by specifically targeting the working-age population, especially the young cohort, to provide them with an adequate education level, creating job opportunities, and supporting their self-employment. Efforts need to be made not only to increase the quantity of education but the quality of education as well, especially to enhance general and vocational education quality. As I have discussed above, the majority of the population have a limitation to access tertiary education, which makes the share of the skilled labor force decrease. Indeed, due to a limited job supply and without appropriate education level, the unskilled labor force emigrates to other developing countries, which may cause a worsening of the social-economic conditions of the country.

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A comparison of institutional quality in the South Caucasus: Focus on Azerbaijan

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Much has happened in the three countries of the South Caucasus—namely, Azerbaijan, Georgia, and Armenia—since the collapse of the Soviet Union. Political events, institutional reforms, and economic development have resulted in greater economic welfare in these countries after the painful transition period of the 1990s. However, it remains to be seen whether they have achieved any solid results or whether they still have much to accomplish. While the answer is ambiguous, each country has followed a different political, geopolitical, economic, and institutional path and achieved different economic outcomes despite their close geographical proximity to each other. This paper compares the available data on economic and institutional quality in Azerbaijan, Georgia, and Armenia to portray the overall situation in terms of changes in institutional patterns. Then, special attention is given to Azerbaijan, as the country is considered to be oil-rich and thus resource-dependent. A comparative perspective on institutional quality suggests that Georgia has been a leading country in terms of institutions and effective bureaucracy-building, despite having lower economic indicators compared to Azerbaijan. Moreover, while Armenia is positioned between Georgia and Azerbaijan in terms of institutional quality, its economic growth is similar to Georgia's. Lastly, institutional variables (e.g., control of corruption, rule of law, and government effectiveness, and human rights) in Azerbaijan are negatively correlated with oil-related variables. This result aligns with the natural resource curse and Dutch disease theories, which posit that oil boom periods in mineral-rich countries are associated with a deterioration in institutional quality, thereby leading to slower growth. Also, the results are important to build up analytical frameworks to address the Dutch disease or resource curse studies in the case of Azerbaijan in a comparative manner with oil-poor countries even if the scope is limited to the South Caucasian former Soviet Union countries.

Keywords: South Caucasus, Azerbaijan economy, oil boom, institutional quality, correlation analysis

1. Introduction

Azerbaijan, Georgia, and Armenia are located in the most unstable part of the former Soviet Union. Nixey (2010, 125) described this region as follows: "existing at the intersection of Europe, Asia, and the Middle East, they share profoundly rooted colonial traumas, Soviet-era poor practice, economic mismanagement, inequality, societal challenges, dysfunctional governments, contradictory impulses towards authoritarianism and change, inter-ethnic discord, boundary tensions, and many low-intensity (or 'frozen') wars." From an economic standpoint, De Waal (2012) called the South Caucasus a "broken region" due to the countries' lack of economic integrity to address chronic poverty, isolation, and interethnic majority–minority issues. Similarly,

Korganashvili et al. (2017) argued that, despite the many transformations—economic, political, and institutional—that have taken place in the South Caucasus, these have failed to yield any solid results, as the region remains one of the most problematic in the world. However, despite its long-standing image as an unstable or "broken" region, the South Caucasus holds considerable economic, political, and geographic importance.

The South Caucasus became a regional hotspot after the dissolution of the Union of Soviet Socialist Republics (USSR) in 1991 due to economic collapse, conflict, and a sudden deterioration in living standards (Matveeva 2002). Azerbaijan, Georgia, and Armenia experienced an increase in income inequality at the beginning of the transition period and a slowdown in economic decay in the late 2000s (Aristel and Perugini 2012). Aristel and Perugini (2012) attribute economic slowdowns to the transition from a command economy to a market economy. Although the economic downturns slowed in the early 2000s, a middle class formed in the region over a period of only eight to nine years. According to Roberts and Pollock (2011), members of this middle class became well-educated, and extensively employed by the public sector.

Each country followed a different pathway of economic, political, and institutional development. According to Simão (2011, 34), "the end of physical and intellectual isolation" after the break-up of the Soviet Union enabled the South Caucasian countries to perceive their strategic value to neighboring regions, including the European Union (EU), the Middle East, and Asia. Notably, Azerbaijan engaged in cooperation with Turkey, the EU, the United States, and Middle Eastern countries; Georgia fostered ties with Europe and the United States; and Armenia established economic and political partnerships with Russia (Pismennaya et al. 2017). After initial geopolitical routes were established, the strategic position of the South Caucasus led various stakeholders to implement international projects, which in turn increased the region's energy transit role. More specifically, the region's economic importance increased after the implementation of energy projects led by Azerbaijan and Georgia, which conveyed Azerbaijan's energy resources to world markets (Nixey 2010).

The integration of the South Caucasus regional market and global markets has taken place since the late 1990s. For instance, economic projects such as the Baku–Tbilisi–Ceyhan (BTC) oil pipeline and the Baku–Tbilisi–Erzurum (BTE) gas pipeline have increased ties between Azerbaijan, Georgia, and Turkey (Cornell and Ismailzade 2005). In addition, the South Caucasus gained importance as a transit hub between Europe and Asia with the establishment of transportation projects such as the Baku–Tbilisi–Kars railroad (Lussac 2008). China's Belt and Road Initiative (BRI) also increased the role of the South Caucasus as a recent economic initiative (Kohli et al. 2019). Chang et al. (2013) reported that, as part of increasing economic and political globalization, Azerbaijan's high energy exports, which also integrated Georgia and Turkey into international commodity markets, have led to greater economic growth in the South Caucasus. Although the South Caucasus has undergone rapid transformation and economic growth, conflicting realities have contributed to an ambiguous impression of the countries' real economic capacity and long-term sustainable prospects.

Despite Azerbaijan's wealth from oil resources, democratization in Georgia, and support from a large diaspora and various aid programs in Armenia, poverty remains widespread in the South Caucasus 20 years after the collapse of the Soviet Union (Pearce et al. 2011). Furthermore, separatism has negatively impacted the

regional economy (Malek 2006). Despite the geographical proximity of the region's countries, wars and intercountry political disagreements disintegrated the region. Moreover, demographic shrinkage and unemployment are widely observed phenomena in the South Caucasus. Thus, solutions to the conflict resulting from country-specific realities, such as poverty, unemployment, inflation, demographic shrinkage, and official economic breakthrough, should be sought in institution-building, as institutions have become important determinants of the countries' economic output in recent years.

The role of institutions has been a focal point in development economics since the late 1990s, as it provided an alternative to theories that usually identified a lack of skills, technology, or capital as the source of economic and social problems (Holmberg et al. 2010). "Institutions" refers to the rules of the game and the organizations that enforce, execute, and promote these rules (Arkadie 1989). The quality of institutions determines the flow of foreign direct investments (FDI) and propensity to be corrupt (Yi et al. 2019); the activity level of entrepreneurship (Sautet 2020); innovativeness (Ventura et al. 2019), terms-of-trade volatility, government debt levels, and cost of servicing sovereign government debt (Bergman and Hutchison 2020); urbanization and city growth (Vernon et al. 2007); and economic diversification (Boschma and Capone 2015). In addition, there is a causal relationship between the quality of government, economic strength, and poverty reduction (Holmberg et al. 2010). Thus, the role of institutions in the South Caucasus should be analyzed to identify change patterns, convergences, and responses to the transition process and contextualize the region's economic growth and potential.

The legacy of the Soviet era significantly impacted the institution-building process during the transition period (Alieva 2000). Large-scale Sovietization changed social structures, eliminated traditional means of economic production, and aligned social standards with "Soviet standards" (Aliyev 2015b). "In other words, the Caucasus inherited a number of imperfect civil and state institutions, but the very same system produced politicians capable of acting in the absence of these institutions (Alieva 2000, 26)." Nevertheless, Russia remains highly influential to economic development in the South Caucasus (Silagadze 2019).

However, the region has not only attracted attention due to its economic projects and developments but also due to the war between Russia and Georgia in August 2008, which drew in large powers such as the United States (Nixey 2010). Freizer (2016) argued that the Russo-Georgian war, Russia's annexation of Crimea in 2014, and growing military clashes and tensions between Azerbaijan and Armenia since 2016 have divided the countries' aspirations towards the West. While Georgia is strongly pro-EU and pro-West in terms of institution-building, Armenia has rejected various partnership opportunities in favor of the pro-Russian Eurasian Economic Union, and Azerbaijan retains a balanced foreign policy. Therefore, considering the economic importance of the South Caucasus and the intersection of geopolitical interests, Nixey (2010, 125) viewed Georgia, Armenia, and Azerbaijan as three countries that could "create big problems for great powers" despite their small size. Thus, adopting a wider view of the South Caucasus enables an examination of the role and importance of domestic institutions in addressing economic, political, geopolitical, and military challenges.

According to Freizer (2016), conflicts in the South Caucasus have negatively impacted state-building, human rights, democratic institutions, economic growth, and regional trade. Therefore, economic integration and social and institutional endowments should be ensured to achieve peace and compatibility of the countries in order to enable long-term cooperation (Kupchan 2010). However, this may not be possible without efficient institution-building, which could in turn lead to sub-optimal economic performance. In fact, various researchers have raised concerns about Georgia, Armenia, and Azerbaijan's ability to catch up to developed countries in institutional and political terms.

This paper is based on the concept of change patterns in institutional quality in the South Caucasus, with a special focus on Azerbaijan. However, simple country comparisons are not sufficient to understand the underlying reasons for changes in institutional quality. Therefore, this study also uses correlation analysis to clarify the role of the oil sector in Azerbaijan to gain an insight into the mutual dynamics regarding the institutional variables. As the paper devotes and exclusive attention to Azerbaijan, the novelty of the current work is the correlation analysis which is based on country-specific de-trended data collected from various sources to portray the institutional change patterns in relation to the changes in the main oil-related variables. The research questions are as follows:

1. How has institutional quality in the South Caucasus changed since the collapse of the USSR?
2. What is the relationship between the oil sector-related economic indicators in the Azerbaijani economy and institutional quality?

The main research objectives cover the description and exploration of the institutional quality in the South Caucasus, comparison of the Azerbaijan-specific institutional quality to underlie the correlation with oil-related variables, and argument to evaluate the critical periods of Azerbaijan's institutional changes since independence. The answered questions and results represent an importance for the policymakers and scholars who seek to identify the possible adverse effects of the booming oil sector in the Azerbaijani economy. Therefore, institutional differences among the oil-rich and oil-poor countries in the region might reflect the further actions of the Azerbaijani government to overcome the policy failures to prevent the rent-seeking behavior or rentier state model that lacks sustainable long-term economic growth and development. Also, the diversification problem that occurs unfruitfully can be related to the institutional quality issues.

The paper is organized as follows: Section 2 describes data characteristics, data sources, and methodology; Section 3 presents the results from a comparison between Georgia, Armenia, and Azerbaijan and an Azerbaijan-specific analysis; Section 4 contains the discussion; and Section 5 provides concluding remarks.

2. Data and Methodology

The current study descriptively compares annual economic and institutional variables from the South Caucasus countries to explore differences and change patterns, mainly from 1996 to 2019. There are many reasons why institutional quality differs from

country to country, but Azerbaijan's economic dominance is understandable, given its rich oil and natural gas reserves. Identifying why institutional quality differs between countries is a challenging task, but this study is one of the first to systematically evaluate these differences. To this end, key economic and institutional variables are graphically analyzed to emphasize key periods and explore trends. More revealing further works are needed to explore cause-and-effect relationships in the institutional change patterns and important economic and geopolitical factors.

This paper focuses on Azerbaijan by investigating changes in institutional quality during the oil boom period (2008–2019), as measured through State Oil Fund revenues and proposed time period for the oil booming by Niftiyev (2020a). Furthermore, a Pearson's R correlation analysis was used to establish a preliminary picture of the association between institutional quality and oil-related variables. Although correlation analysis cannot provide a full assessment of institutional quality, it provides the necessary conceptual grounding to conduct future follow-up studies.

In this paper, institutional quality is measured through variables derived from the World Bank (2021a), such as voice and accountability, political stability, absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. In addition, for Azerbaijan, additional variables such as human rights scores (Farris 2019), property rights (The Global Economy 2021), higher court independence, and the clean elections index were used from the data set provided by Coppedge et al. (2021). Table 1 provides a summary of the institutional variables used in descriptive statistics, the normality test, and the correlation analysis. Furthermore, as the appropriated indicators are exhaustive in this paper due to its comparative nature, the current section does not explain, describe and define the variables of interest individually. Accordingly, the results section of this paper contains brief explanations and individual levels of measurement for those variables as part of the description of the collected data (in other words, the necessary paragraphs in the results section will present the meaning of the employed indicators and subsequently, their levels of measurements are attached to each figure to explain how do they measure what they measure).

Table 1 Information about the variables used in descriptive statistics, normality test, and correlation analysis.

Variable name	Description	Variable name	Description
POL_ST	Political stability and absence of violence index	CLEAN_ELEC	Clean elections index
		SH_SOFAZ	Share of SOFAZ in the state budget, in %
CONT_COR	Control of corruption index		
RULE_O_LAW	Rule of law index	OIL_RENTS	Oil rents, % of GDP
GOV_EFF	Government effectiveness	MINING/GDP	Mining-to-GDP, ratio
VO_AND_ACC	Voice and accountability index	OIL_PRICES	Oil prices, USD per barrel
H_RIGHTS	Human rights scores		
PROP_RIGHTS	Property rights index		
HIGHER_COURT_INDP	Higher court independence scores		

Source: own construction

The main data source for the current study is The Global Economy (2021). Other sources include the State Oil Fund of the Republic of Azerbaijan (SOFAZ 2021) from where annual reports for data on the share of SOFAZ in the state budget were gathered, the State Statistical Committee of the Republic of Azerbaijan (SSCRA 2021) for data on mining and Gross Domestic Product (GDP), the World Bank (2021b) for data on oil rents, and the U.S. Energy Information Administration (UIA 2021) for data on oil prices and the Brent trademark.

A correlation analysis was also used for this paper in addition to descriptive and figure analysis. Correlation analysis is a useful quantitative method for assessing the direction and strength of a linear association between two normally distributed variables (Schober et al. 2018). A Pearson's R correlation analysis was used because most of the variables were normally distributed – one of the main assumptions of Pearson's R correlation – and ranged between –1 and +1. The correlation grows weaker as the value of Pearson's R approaches 0 and grows stronger as it approaches either –1 or +1, which indicates a negative and positive correlation, respectively. Table 2 reports descriptive statistics of the variables used in the correlation analysis (Gogtay and Thatte 2017).

Table 2 Descriptive statistics of variables used in the correlation analysis.

	N	**Min.**	**Max.**	**Mean**	**Std. dev.**	**Var.**	**Skewness**	**Kurtosis**
POL_ST	24	–1.193	–0.239	–0.737	0.260	0.068	0.186	–0.371
CONT_COR	24	–1.446	–0.829	–1.116	0.172	0.030	0.080	–0.778
RULE_O_LAW	24	–1.201	–0.520	–0.861	0.202	0.041	–0.100	–0.773
GOV_EFF	24	–1.006	–0.100	–0.661	0.302	0.091	0.776	–0.790
VO_AND_ACC	24	–1.565	–0.906	–1.241	0.214	0.046	–0.065	–1.293
H_RIGHTS	24	–0.756	–0.021	–0.327	0.161	0.026	–0.197	1.199
PROP_RIGHTS	24	20.000	59.000	30.167	10.441	109.014	1.666	2.588
HIGHER_COURT_INDP	24	0.165	0.815	0.621	0.258	0.067	–0.946	–1.105
CLEAN_ELEC	24	0.058	0.173	0.108	0.037	0.001	0.410	–0.915
SH_SOFAZ	24	7.300	60.400	30.804	21.378	457.037	0.018	–1.909
OIL_RENTS	24	3.618	39.558	24.021	8.927	79.686	–0.238	–0.134
MINING/GDP	24	0.188	0.579	0.391	0.110	0.012	–0.046	–0.580
Oil_PRICES	24	12.760	111.630	56.760	31.984	1022.973	0.382	–1.035

Note. Calculated in SPSS.
Source: own construction

Before the correlation analysis, the variables were detrended using the Hodrick-Prescot filter in Microsoft Excel software, version 15.26 for Mac operation system (OS). The smoothing parameter – lambda was 100 due to the annual data type. Table 3 reports the results of the Shapiro-Wilk normality test, which show that the variables were normally distributed (excluding human rights scores and the higher court independence index). This means that Pearson's R correlation analysis can be used.

Table 3 Results of Shapiro-Wilk normality test.

	Shapiro-Wilk statistic	df	Sig.
POL_ST	0.964	24	0.519
CONT_COR	0.984	24	0.953
RULE_O_LAW	0.961	24	0.453
GOV_EFF	0.947	24	0.233
VO_AND_ACC	0.960	24	0.429
H_RIGHTS	0.912	24	0.039
PROP_RIGHTS	0.947	24	0.233
HIGHER_COURT_INDP	0.913	24	0.041
CLEAN_ELEC	0.940	24	0.160
SH_SOFAZ	0.972	24	0.711
OIL_RENTS	0.960	24	0.432
MINING/GDP	0.977	24	0.837
Oil_prices	0.966	24	0.576

Note. Calculated in SPSS; *df* denotes the degrees of freedom.
Source: own construction

The variables for voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption had values missing for 1997, 1999, and 2001. Thus, the missing values were replaced by the average values of 1996 and 1998 for 1997; 1999 and 2000 for 1999; and 2000 and 2002 for 2001.

Various institutional variables have been utilized to conduct the analysis. They are as follows: the rule of law index measures the extent to which citizens trust the quality of contract enforcement and property rights, the police, and the courts, as well as the overall propensity for crime and violence in society. The government effectiveness index reflects the quality of public services and the degree of freedom from political pressures. The control of corruption index describes the extent of petty or grand corruption and state capture in each country. Lastly, the regulatory quality index measures the extent to which regulations promote the development of the private sector through efficient and sound policies.

Other indicators that served as proxies for institutional quality were voice and accountability, political stability, corruption perception, and political rights indices. The voice and accountability index encompasses issues related to a free press, free speech, and participation in government elections, while the political stability index evaluates the likelihood of terrorism and the unconstitutional and violent replacement of the government. The corruption perception index tracks the degree of public sector, political, and administrative corruption. The political rights index – which was devised by Freedom House – evaluates the electoral process, political pluralism, participation, and government functioning, which are crucial dimensions of the quality of a country's political institutions.

The civil liberties index captures individual rights, freedom of self-expression, personal autonomy, and associational and organizational rights. The cost of starting a

business is a suitable measure of institutional quality because it examines the official fees required by law to initiate commercial activities. Rising costs may reflect artificial barriers for business entities. Moreover, since the index excludes bribes, a decreasing number of businesses in the face of decreasing costs may indicate that unofficial payments are required to start a business. The latter scenario results from institutional deterioration and can also be traced to the share of the shadow economy in the national economy. The calculation for the size of the shadow economy was based on Medina and Schneider's (2018) methodology and provided by The Global Economy (2021). Lastly, the overall economic freedom index was used to assess the national economy in terms of market openness, regulatory efficiency, limited governments (unnecessary interventions by the governments), and rule of law.

Additional variables were useful for shedding light on the post-boom period in Azerbaijan. For example, the fragile state index describes a government's capacity to handle conflicts, together with the reflections of the necessary aspects of pre-conflict and post-conflict handling stages. The fragile state index also encompasses the security apparatus, human flight, brain drain, economic development, and certain aspects of state legitimacy. The state legitimacy index covers similar concerns as the fragile state index and tracks citizens' trust and confidence in the government and the manifestation of easiness of strikes and mass demonstrations. Furthermore, the uneven economic development index measures inequality, irrespective of economic performance (by mainly considering institutional capacity), and the human rights and rule of law index measures the extent to which fundamental human rights are protected. Overall, these indicators too can help understand the additional directions of institutional quality in Azerbaijan.

3. Results

This section presents the results of the comparisons of economic and institutional variables. An institutional comparison allows differentiating among the South Caucasus countries in contrast to economic achievements and overall political and geopolitical climate in the region. The first results sub-section compares economic and institutional conditions in Georgia, Armenia, and Azerbaijan, while the second and third sub-sections focus on the role of oil in institutional quality in Azerbaijan.

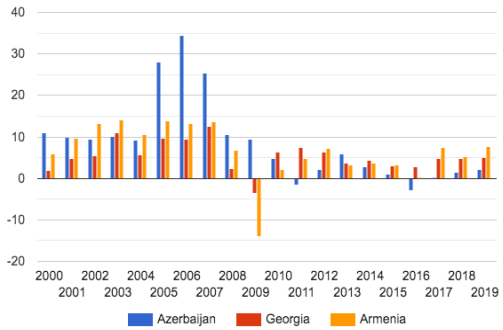
3.1. Comparison of three post-Soviet South Caucasus countries

GDP and GDP per capita provide a bird's-eye view of a country's economic performance. Figure 1 (panels *a* and *b*) depict economic growth between 2000 and 2019, as measured in GDP and GDP per capita. Throughout this period, Azerbaijan was the clear leader in terms of GDP in current prices, followed by Georgia (see Figure 1, panel *b*). The rate of change of real GDP was consistently high in Armenia, while Azerbaijan saw notable increases during the oil boom (e.g., 27.96%, 34.47%, and 25.46% growth in 2005, 2006, and 2007, respectively). Georgia's economic growth lagged behind that of both Azerbaijan and Armenia between 2000 and 2009 but improved from 2010 to 2019.

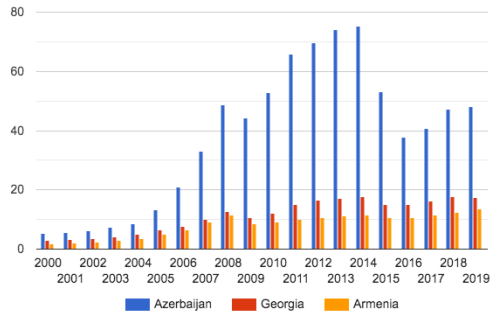
Figure 1 (panel *c*) shows that GDP per capita in current U.S. dollars was similar in all three countries between 2000 and 2005, but Azerbaijan outpaced its neighbors between 2006 and 2014 and 2018 and 2019. Over the same periods, Armenia and Georgia shifted their places, with Georgia occupying a lead position since 2011. Moreover, in terms of purchasing power parity, Georgia has seen a consistent upward trend in GDP per capita since 2009, even outgrowing Azerbaijan in 2018 and 2019 for the first time in 19 years (see Figure 1, panel *d*). In Armenia's case, there are also developments similar to Georgia.

Figure 1 Changes in select economic indicators in the countries of the South Caucasus (2000–2019).

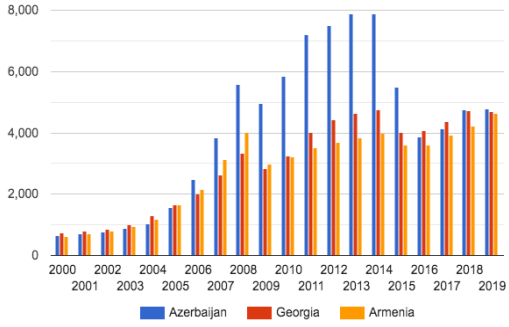
a. Rate of change of real GDP, in percent



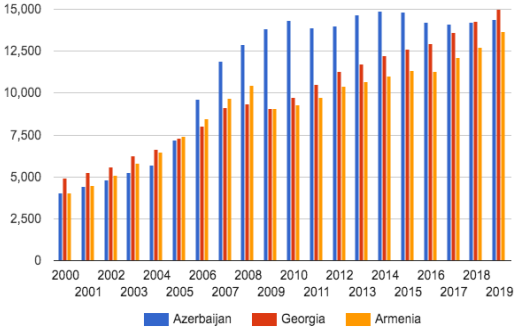
b. Gross domestic product, in billions of U.S. dollars



c. GDP per capita, in current U.S. dollars



d. GDP per capita, in purchasing power parity



Sources: The Global Economy (2021); The World Bank (2021).

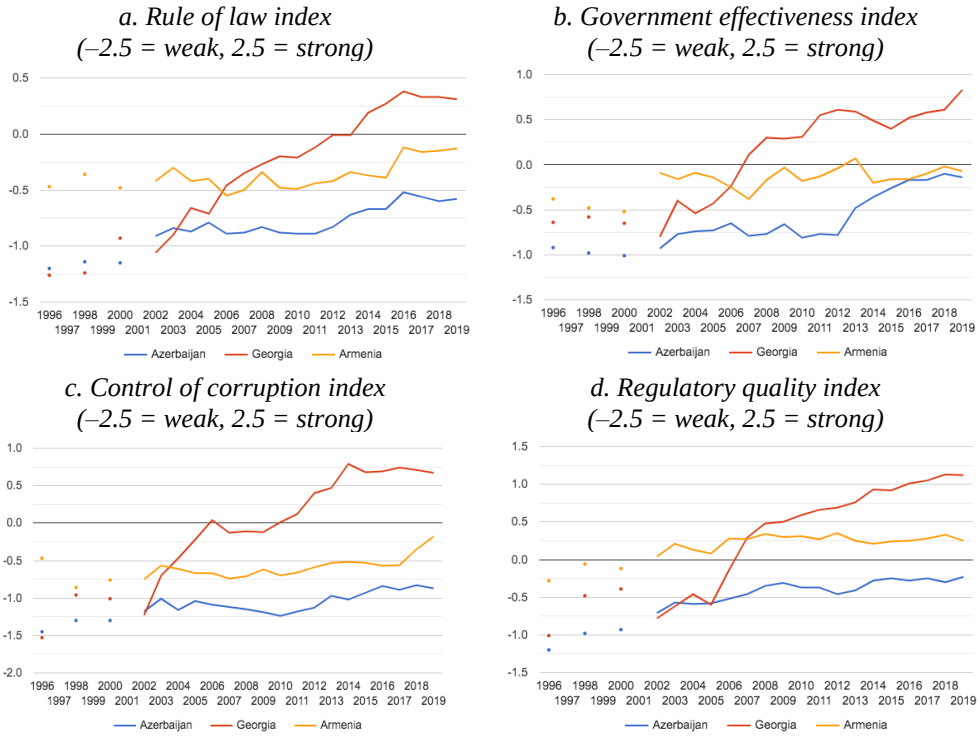
In terms of institutional variables such as rule of law, government effectiveness, control of corruption, and regulatory quality, Georgia has maintained a leading position since 2005 (see Figure 2, panels *a*, *b*, *c*, and *d*). Georgia was the only country that exhibited positive values on the rule of law index, beginning in 2013; however, a downward trend was observed from 2016 onwards (see Figure 2, panel *a*). Conversely, Azerbaijan had the lowest values, which hovered between –1.0 and –0.5 from 2002 to 2019. Armenia was somewhere in the middle. Results for the rule of law and other indices highlight that Georgia had the lowest values for institutional quality towards the end of the 1990s, while Azerbaijan and Armenia had relatively higher levels of institutional quality.

Figure 2 (panel *b*) shows that the government effectiveness index in Armenia fluctuated between –0.09 and –0.07 in 2002 and 2019 and did not exhibit notable improvement, while government effectiveness in Azerbaijan considerably increased from –0.78 in 2012 to –0.10 in 2018. Although Georgia and Azerbaijan started in similar positions in 2002, government effectiveness in Georgia had improved by 203.75% by 2019.

Figure 2 (panel *c*) displays changes in the control of corruption index within the three countries. Although Azerbaijan and Armenia exhibited modest and slightly better-than-modest improvements, respectively, Georgia has been in the lead since 2003. However, Armenia experienced a sharp increase in control of corruption in 2015, while the situation leveled off in Georgia and Azerbaijan.

Similarly, Georgia had the highest values in the regulatory quality index since 2007 (a jump of 146.56% compared to 2005), but Armenia's position remained virtually unchanged between 2006 and 2018. Despite a positive upward trend that can be observed between 1996 and 2019, Azerbaijan still lagged behind the two other countries in terms of regulatory quality (see Figure 2, panel *d*).

Figure 2 Changes in selected institutional variables in the countries of the South Caucasus (1996–2019).



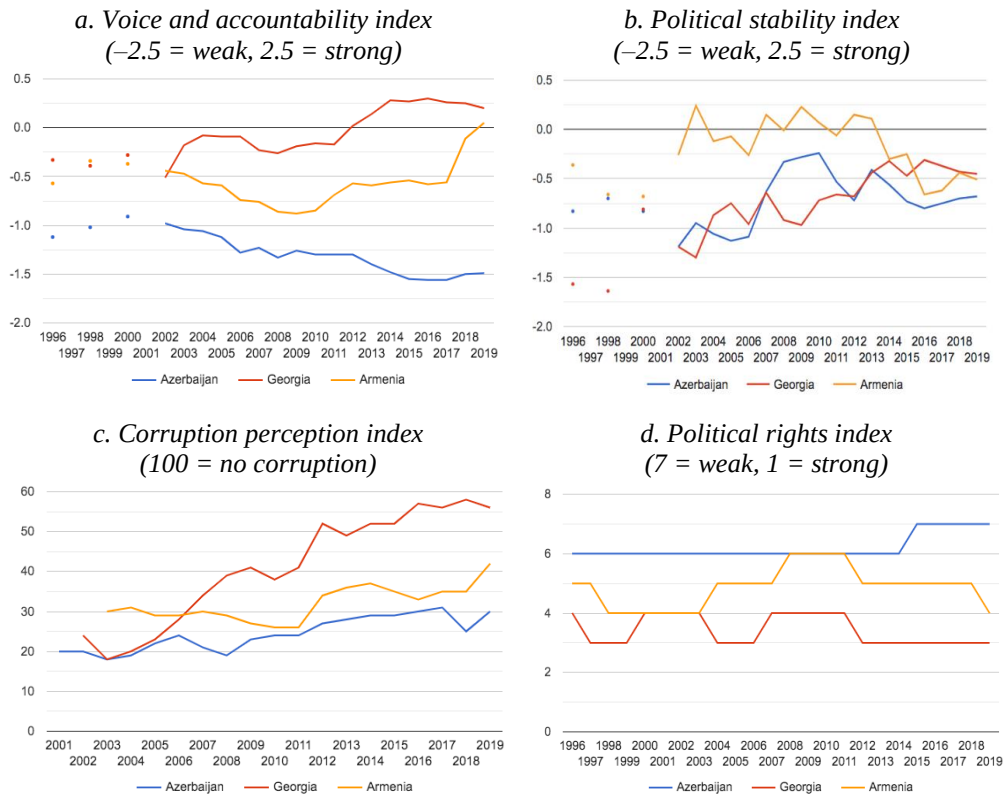
Sources: The Global Economy (2021); The World Bank (2021).

Georgia occupied a leading position with regard to the voice and accountability index. While Armenia began to converge with Georgia in 2017, the situation worsened in Azerbaijan (see Figure 3, panel *a*). The political stability index showed a similar but highly volatile picture – sometimes worsening, sometimes improving – in all three countries (see Figure 3, panel *b*).

Within a short period of time, Georgia surpassed both Azerbaijan and Armenia in terms of corruption perception (see Figure 3, panel *c*). However, Azerbaijan and Armenia also began to demonstrate improvements on the corruption perception index, as there was an upward trend in both countries.

Figure 3 (panel *d*) shows that, between 1996 and 2019, Georgia led the political rights index with a consistent score of 3–4. Meanwhile, Armenia's political index score fell from 4 in 2003 to 6 in 2011, but it recovered to 4 in 2019. However, the trend remained stable in Azerbaijan; the country had a score of 6 between 1996 and 2014, which declined to 7 in 2015 and remained consistent until 2019.

Figure 3 Changes in selected institutional variables in the countries of the South Caucasus (1996–2019).



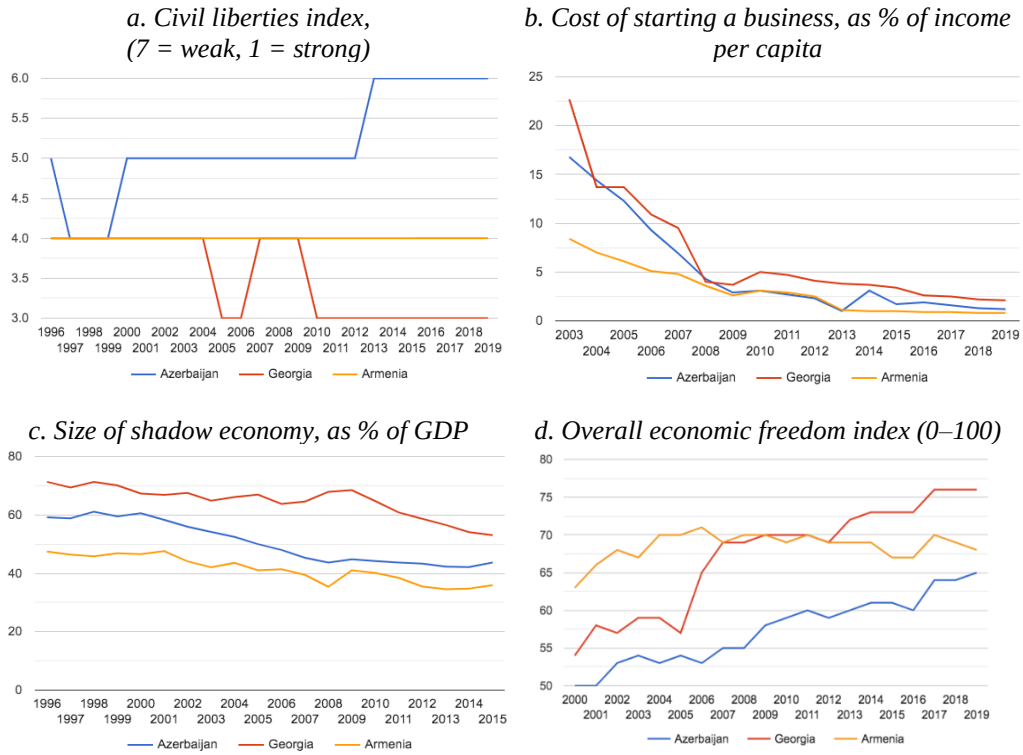
Sources: The Global Economy (2021); The World Bank (2021).

Figure 4 presents a third set of institutional variables to compare institutional quality in the three South Caucasian countries: the civil liberties index, the cost of starting a business, the size of shadow economy, and the overall economic freedom index. In Armenia, the status of civil liberties did not change over the 23-year period under examination (Figure 4, panel *a*). In Azerbaijan, civil liberties only improved between 1996 and 1999. Then, in 2000, Azerbaijan began to fall behind its two neighbors. In Georgia, civil liberties remained stable and the best values since 2010.

All three countries experienced a decline in the cost of starting a business between 2003 and 2019 (see Figure 4, panel *b*). More dramatic declines took place in Georgia (from 22.7% of income per capita in 2003 to 2.1% in 2019) and Azerbaijan (from 16.8% of income per capita in 2003 to 1.2% in 2019). In Armenia, the cost of starting a business decreased from 8.4% of income per capita in 2003 to 0.8% in 2019. However, the cost of starting a business was similar in terms of monetary values in all three countries during the last years as can be observed from Figure 4, panel *b*.

The size of the shadow economy was greatest in Georgia and smallest in Armenia, measured as a percentage of GDP (see Figure 4, panel *c*). Although Azerbaijan was ranked second and saw the sharpest declines in the size of its shadow economy, the share of the latter relative to the national economy increased from 42.15% in 2000 to 43.66% in 2014. A similar upward trend can be observed in Armenia since 2013.

Figure 4 Changes in selected institutional variables in the countries of the South Caucasus (1996–2019).



Sources: The Global Economy (2021); The World Bank (2021).

Figure 4 (panel *d*) shows that overall economic freedom improved over a 20-year period in the South Caucasus. In Georgia, economic freedom dramatically increased, reaching 76 index points in 2019 and notably increasing by 21.05% from 2005 to 2007. Azerbaijan also achieved positive—albeit more gradual—growth. However, Armenia did not conform to this trend, exhibiting a similar level of economic freedom from 2015 to 2019 as it did from 2000 to 2003.

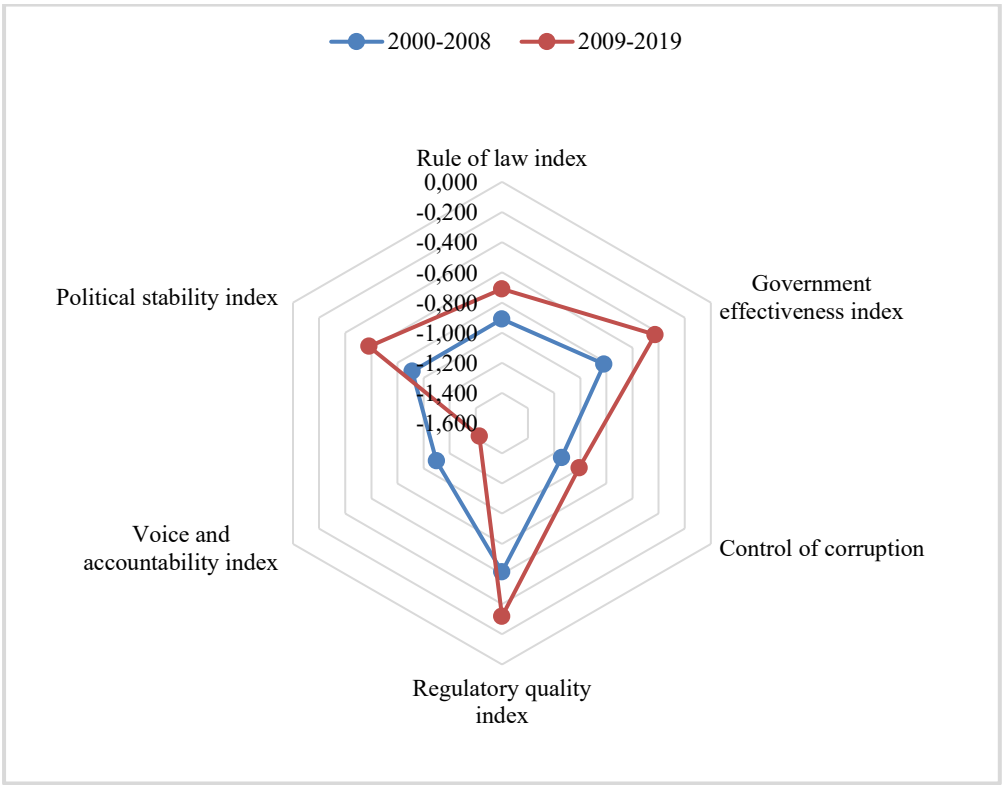
3.2. The relationship between institutional quality and oil in Azerbaijan

According to the natural resource curse, it is expected that lower institutional quality will be observed in mineral-rich countries during and after boom periods. Economic explanations of structural issues in such countries have drawn much attention, but these have recently been replaced by institutional explanations. Kolstad (2009) argued that sub-optimal social outcomes can be linked to poor institutions. Public sector employment and state subsidies rapidly increase during resource booms and can be channeled to various interest groups to secure votes (Azerki–Van der Ploeg 2007). In other words, the ability of entrepreneurs to choose between productive activities and rent-seeking depends on how institutional indicators such as rule of law, government effectiveness, and the quality of bureaucracy shape relative profitability (Mehlum et al. 2006). Similarly, Robinson et al. (2006) indicated that an incumbent politician can generate patronage networks to attract voters through extracted natural resources, which in turn creates inefficiencies in the public sector. Thus, institutional quality identifies the extent to which resource richness can negatively influence the private and public sectors.

As discussed in the first results subsection, multiple indicators were used to measure institutional quality and change patterns. Georgia, Armenia, and Azerbaijan have differed in terms of institutional progress since the collapse of the Soviet Union and the ensuing transition period. In addition, Azerbaijan's oil-led economic development and growth further distinguished it from its neighbors. Therefore, it can be assumed that there were differences in institutional quality in Azerbaijan that influenced the natural resource curse. Accordingly, by comparing institutional quality in Azerbaijan before and after the oil boom periods, it may be possible to identify differences resulting from a rise in oil extraction, exports, and prices. In fact, Ahmadov et al. (2013) have argued that natural resource rents adversely influence government effectiveness in the oil-rich countries of the Caspian Basin, where Azerbaijan is also located.

As illustrated in Figure 5, only one institutional indicator – the voice and accountability index – exhibited a lower average value (–1.43), while all other institutional indicators improved during the post-boom period (2009–2019) compared to the pre-boom period (2000–2008). The political stability and government effectiveness indices also noticeably improved during the post-boom period (from –0.91 to 0.58 and –0.82 to –0.43, respectively), while rule of law, control of corruption, and regulatory quality showed only slight improvements. However, the precise role of the oil revenue remains unclear. Moreover, there is a natural trend in institutional quality, which inflates overall improvements over the recent tie periods. Thus, the average of pre-boom and post-boom periods of year-over-year growth rates were calculated and compared in Figure 6.

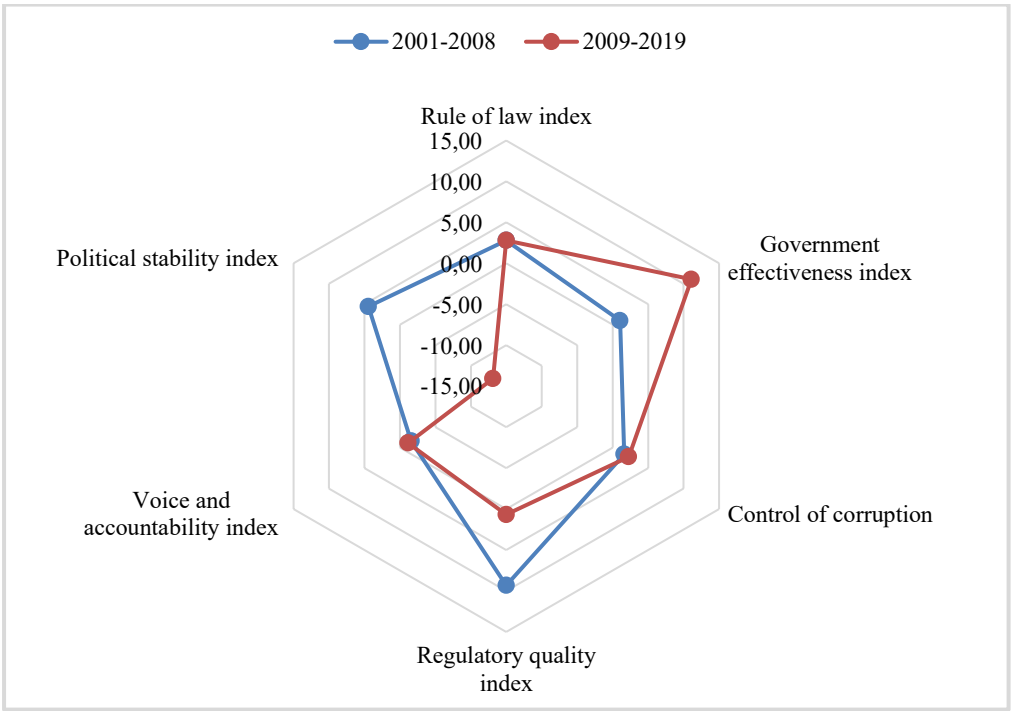
Figure 5 Pre-boom (2000–2008) and boom, and post-boom (2009–2019) averages of the institutional indicators in Azerbaijan.



Sources: The Global Economy (2021); The World Bank (2021).

According to Figure 6, the bold averages of the institutional indices may not reflect the truth, as year-over-year growth averages show little or no improvements in rule of law, voice and accountability, and control of corruption. In addition, the political stability index failed to show any significant improvement during the post-boom period, lagging far behind other institutional variables and falling from an average value of 4.45% from 2000 to 2008 to –13.12% from 2009 to 2019. On average, regulatory quality index also fell during the post-boom period, declining from 9.32 % to 0.67 %. Only the government effectiveness index improved, from an average of 1.3% from 2001 to 2008 to 11.11% from 2009 to 2019; this aligns with the findings in Figure 5.

Figure 6 Pre-boom (2001–2008) and boom, and post-boom (2009–2019) year-over-year growth averages of the institutional indicators in Azerbaijan.



Sources: The Global Economy (2021); The World Bank (2021).

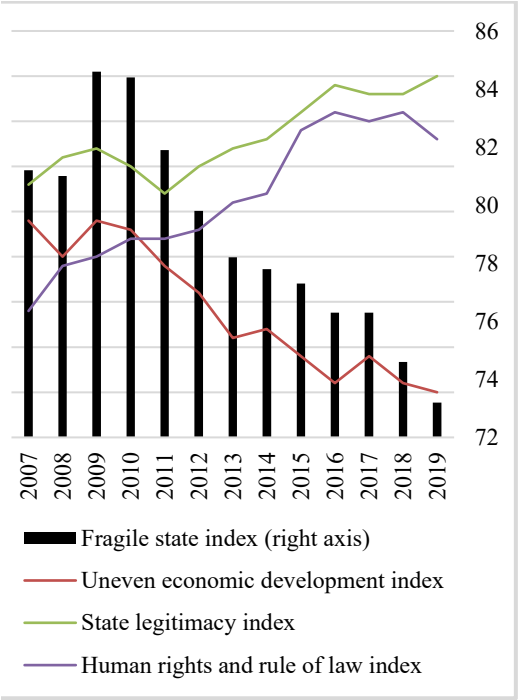
In terms of fragility, Figure 7 (panel *a*) demonstrates that, starting from 2009, Azerbaijan's fragility in pre-conflict, active conflict, and post-conflict situations improved despite the serious weakening represented by the period from 2009 to 2010 (The Fund for Peace 2021). The uneven economic development index also improved, decreasing from 7.4 in 2009 to 5.5 in 2019. However, the opposite trend was observed for the state legitimacy index. As soon as the boom period ended in 2011, the latter began to worsen.

As measured by the Fund for Peace's (2021) human rights and rule of law index, institutional quality decreased in Azerbaijan throughout nearly the entirety of the boom and post-boom periods. From 2015 to 2019, there was a slight downward trend in the human rights and rule of law index, which represents progress.

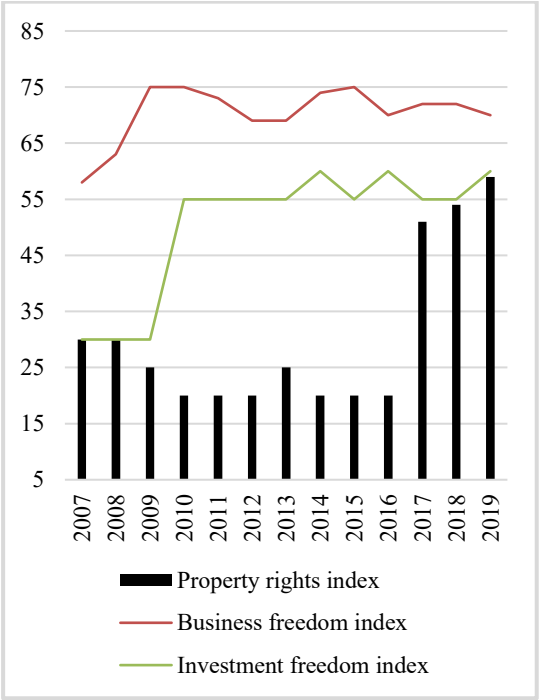
Figure 7 (panel *b*) also depicts additional institutional variables in Azerbaijan. These include the property rights index, which measures how the government enforces property protection; the business freedom index, which evaluates the ability to start, operate, and close a business; and the business freedom index, which measures restrictions on investments within and across countries. Business freedom was found to be volatile after a period of noteworthy growth from 2007 to 2009; it worsened between 2015 and 2019, moving from an index value of 75 to 70. By contrast, property rights rapidly improved between 2017 and 2019. Lastly, the business freedom index took a sharp development in 2010 and hovered between an index value of 55 and 60.

Figure 7 Changes in institutional variables in Azerbaijan, during the boom and post-boom periods (2007–2019).

a. Fragile state index (0 = low to 120 = high), uneven economic development index, (0 = low to 10 = high), state legitimacy index, (0 = high to 10 = low), and human rights and rule of law index (0 = high to 10 = low).



b. Property rights index, (0 = low to 100 = high), business freedom index (0 = not free to most free =100), investment freedom index (0 not free to most free = 100).



Sources: The Global Economy (2021); The World Bank (2021).

3.3. Correlation analysis

Based on the inter-country comparisons and the analysis of institutional quality in Azerbaijan, the current subsection reports the results of the Pearson's R correlation analysis of oil-related variables and selected institutional indices in Azerbaijan. The examined time period is 1996 to 2019, and the data was detrended. Table 4 summarizes the results of the analysis.

Table 4 Correlation Analysis (Pearson's R) of the detrended data regarded institutional quality in Azerbaijan, 1996–2019.

Variable	SOFAZ's share	Oil Rents	Mining/GDP	Oil Prices
POL_ST	0.761**	–0.071	0.140	0.251
CONT_COR	–0.736**	–0.227	–0.287	–0.365
RULE_O_LAW	–0.640**	–0.289	–0.398	–0.436**
GOV_EFF	–0.736**	–0.220	–0.319	–0.489**
VO_AND_ACC	0.203	0.102	–0.036	0.078
H_RIGHTS	–0.127	–0.310	–0.139	–0.280
PROP_RIGHTS	0.117	0.471*	0.519**	0.146
HIGHER_COURT_INDP	0.504*	0.220	0.319	0.109
CLEAN_ELEC	0.656**	–0.055	0.013	0.161

Note. Calculated in SPSS. (1) The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. (2) Green shading indicates a positive correlation, and orange shading indicates a negative correlation. (3) The sample size for all correlations is 24. (4) Not all institutional variables were included in the correlation analysis. After the first set of experimental correlations were examined, only the most significant and relevant variables were incorporated into the latter.

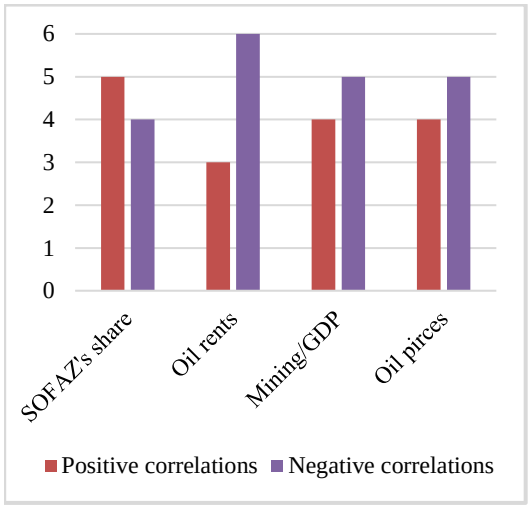
A strong, negative, and statistically significant correlation was found between SOFAZ's share in the state budget and the control of corruption, rule of law, and government effectiveness indices. In addition, a negative correlation—albeit weak and statistically insignificant—was found between SOFAZ's share and human rights scores. Moreover, the analysis revealed both statistically significant and insignificant and a positive correlation between SOFAZ's share and the political stability, higher court independence, clean elections, and voice and accountability indices. It should be noted that SOFAZ's share exhibited the highest number of statistically significant correlation coefficients compared to other oil-related variables in the correlation matrix.

In addition, oil rents were found to have mainly negative but weak associations with institutional quality in Azerbaijan. Only one statistically significant and positive correlation was found between property rights (0.471) and oil rents. The voice and accountability and higher court independence indices were also positively correlated with oil rents.

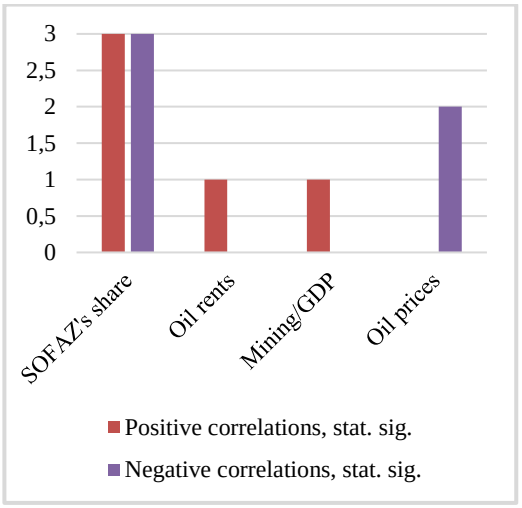
Multiple negative correlations—mostly statistically insignificant—were also found between mining-to-GDP (mining industry's share in GDP) and institutional variables, excluding the political stability, property rights, higher court independence, and clean elections indices. The correlation analysis yielded only one statistically significant correlation between mining-to-GDP ratio and the property rights index (0.519).

Figure 8 Frequency of positive and negative correlations between the oil-related variables and institutional variables.

a. Distribution of positive and negative correlations across oil-related variables.



b. Distribution of statistically significant positive and negative correlations across oil-related variables.



Note. Calculated in SPSS.

Lastly, oil prices were found to be negatively correlated with control of corruption, human rights, rule of law, and government effectiveness; the last two correlations were statistically significant. Oil prices were also positively correlated with political stability, voice and accountability, property rights, higher court independence, and clean elections; however, these correlations were not statistically significant.

The results of the Pearson's R correlation analysis revealed that negative correlations between institutional quality and the oil sector in Azerbaijan outweighed positive correlations (see Figure 8, panel *a*). More specifically, there were 20 negative coefficients and 16 positive coefficients. However, only SOFAZ's share and oil prices were statistically significant, with three and two negative coefficients, respectively (see Figure 8, panel *b*). In addition, oil rents and oil prices had one positive and statistically significant correlation coefficient each, without any statistically significant negative coefficients.

4. Discussion

Post-Soviet countries still face challenges in terms of fostering institutions, state-building, and catching up to developed countries due to issues that arise from premature bureaucracy and inadequate governmental policies. Institutional quality strongly differs between Georgia, Armenia, and Azerbaijan, as measured by various institutional, political, and governance indicators. However, some trends also overlap among transition and South Caucasian countries. For instance, unofficial payments in transition

countries remain widespread (EBRD 2011), and taxpayer honesty is low in the South Caucasus region (Malek 2006). In addition, Aliyev (2015a) argued that there is a high level of informality in Georgia and Azerbaijan due to failed institution-building following transitional challenges and economic and political instability. Moreover, Korganashvili et al. (2017) evaluated the political and economic transformation of the region and concluded that the transformation has not led to any solid benefits for the countries, which gives rise to a serious doubt of the role of domestic institutional quality in socio-economic development. There are also external factors that decrease the motivation of governments in the South Caucasus to achieve a high rule of law. For example, in Azerbaijan, the EU's oil interests decrease pressure on the national government to promote reforms and fill the blank gaps in institution-building to integrate with the EU (Guliyeva 2005).

In the early 1990s, internal and external threats forced the South Caucasian countries to adopt presidential power, which in turn gave rise to patronage. In Armenia, the effects of nationalism and the Nagorno-Karabakh war in the early 1990s were heavily felt, while a more balanced domestic and foreign policy was apparent in Azerbaijan and Georgia (Alieva 2000). However, more recent developments in the form of military actions between Russia and Georgia show the fragility of the overall situation in the region (Kakachia 2011). Both external and internal factors extensively influence and differentiate conditions of institution-building in the South Caucasian countries.

The results of this study reveal that, despite improved political rights in Georgia and Armenia, the overall political instability of the region remains. Azerbaijan and Armenia seem to exhibit volatile indicators related to the quality of democracy due to ever-changing political and social realities (Malek 2006). In addition, Georgia's occasional difficulties in building a coalition government and Armenia's recent revolution have contributed to this instability. Because the variables that measure the institutional quality of political institutions are highly interdependent, this also sheds light on the underdeveloped status of civil liberties in Armenia and has worsened the situation in Azerbaijan.

The figure analysis suggests that there are particular years in which institutional quality in the South Caucasus dramatically changed. For instance, this corresponds to the period between 2003 and 2004 in Georgia: "since 2004, Georgia has made huge strides toward strengthening state structures, reforming the bureaucracy, and removing corruption from the lives of ordinary citizens" (Beacháin–Coene 2014, 938). This was the result of Mikheil Saakashvili's presidency, which brought pro-democracy, pro-NATO, and pro-European Union policy. Moreover, Aliyev (2015c, 30) argued that "Saakashvili's Georgia achieved a notable success in weakening such deeply rooted informal practices as gift-giving and reciprocal favours offered in return for preferential treatment informal institutions." Georgia's active participation in the Eastern Partnership program, which was initiated by the EU, also positively impacted institutional quality (Delcour 2013). However, Georgia's efforts are considered to be insufficient due to external threats from Russia, low levels of political resistance in parliament, internal failures in state-building, and territorial conflicts such as those in South Ossetia and Abkhazia (Mitchell 2009). Moreover, informal connections, kinship relationships, and friendships still play an important role in job seeking or handling crises in Georgia (Aliyev 2015c). In addition, weak anti-monopoly regulations,

corruption, inefficient state governance, and issues with bureaucracy (Lekashvili 2017) have shed light on why particular institutional variables have started to decline over the past five to six years.

In Azerbaijan, the period from 2009 to 2014 was distinctive, according to the figure analysis in this paper, as civil society experienced difficulties resulting from harsh crackdowns and a decline in educational programs (Ibadoglu 2018). The political rights, civil liberties, and even political stability indices worsened from 2009 to 2014, which overlaps with the early years of the oil boom and post-boom periods. These periods were accompanied by serious shortcomings in public procurement and state budget transparency (Ibadoglu–Bayramov 2019). On the other hand, the business freedom index and investment freedom index sharply improved in 2009, which may reflect increased political stability due to the presidential election in 2008 and constitutional election in 2009. According to Dutta and Roy (2011), higher political stability is associated with high levels of FDI. Moreover, the results of this paper have shown significant developments in the property rights index in Azerbaijan from 2017 to 2019, which may result from crucial developments in real estate registration and transparency improvement in property management (Doing Business 2020).

In Armenia, the most crucial time was 2017, when the non-violent Velvet Revolution occurred. This revolution, along with a series of reforms and institutional changes, improved institutional quality, as measured by the voice and accountability, political stability, political rights, corruption perception, and civil liberties indices. However, it was a difficult task to eliminate all the shortcomings and drawbacks that secluded foreign policy preferences of the previous rulers had brought until 2017. Despite these changes, deep-rooted, country-specific, and systemic challenges did not allow us to expect more (Dorodnova 2019). Recent developments, such as COVID-19 and the second Nagorno-Karabakh war, have deeply destabilized Armenia, pushing it into a political crisis (Taghizade 2021). However, the pre- and post-revolution periods are distinct in terms of the dynamics of institutional quality change patterns in Armenia.

In the South Caucasus, the improvement of institutional quality was closely associated with particular trends, such as the decline of the shadow economy, a decrease in the cost of starting a business, and an increase in economic freedom (excluding Armenia, in the case of the last variable). Informal and non-official parts of the economy are believed to occupy a large share of the economy in ex-Soviet and transitional countries. However, separation from the Soviet Union stimulated the countries of the South Caucasus to reform as quickly as possible in the early 1990s to attract FDI. Despite optimistic trends in the South Caucasus, as measured by the abovementioned institutional variables, quantitative and numerical measurements are still new and may obscure multifaceted issues such as informality in the South Caucasus. Polese and Rekhviashvili (2017) argued that there is a long-standing lack of research on informality in the South Caucasus. Government and institutional failures have stimulated the shadow economy in transition countries (Eilat et al. 2002). The informal economy has accounted for as much as 67.3%, 60.6%, and 46.3% of the economy in Georgia, Azerbaijan, and Armenia, respectively, after a decade of independence from the Soviet Union (Malek 2006). Although the shadow economy has generally been on a downward trend since 2001, there have been some increases in Azerbaijan and Armenia in recent years, which requires more research. Thus, despite positive trends, further institutional

strengthening is needed to improve regulations, bureaucracy, corruption, and the judicial system to combat the shadow economy and associated issues.

The case of Azerbaijan is unique in the region, as the country has followed an oil-led economy, which is usually associated with various challenges in the form of the resource curse or Dutch disease (Ibadoghlu–Conway 2010, Hasanov 2013, Niftiyev 2020b). Despite this, Azerbaijan has implemented various economic reforms to increase diversification, market liberalization, governance efficiency, the efficiency of the banking sector (Aliyev 2015a). Nevertheless, the role of institutions arises when low levels of economic diversification are observed despite all efforts. In fact, Azerbaijan was ranked last in terms of its commitment to reducing the gap between rich and poor around 2010 (EBRD 2011). Moreover, "Azerbaijan is the only country for which satisfaction with service delivery for most public services in 2010 is lower than in 2006" (EBRD 2011, 35).

The main economic indicators, such as GDP, the growth rate of real GDP, and GDP per capita, show that, out of the three South Caucasian countries, Azerbaijan possesses a volatile economy, because it has failed to achieve high growth rates in the real economy after the completion of large oil and natural gas projects. The national economy is highly interconnected with international commodity markets and any boom or bust in oil prices determines export revenue. Although the global financial crisis impacted Armenia and Georgia more severely, Azerbaijan's economic speed slowed down during and after the period from 2014 to 2015, which was notable for sharp downturns in price in international commodity markets. However, one must not think of Azerbaijan's economy as very superior to the other South Caucasian countries or a second-string player among them due to the apparent similarities in socio-economic realities. Labor markets in the South Caucasus share similarities in the form of youth unemployment, low labor productivity, and labor migration to Russia (Pismennaya et al. 2017). Private entrepreneurs must face numerous obstacles, such as a lack of financial support for startups, high levels of inflation, an overwhelmed and low-skilled labor force due to outward migration, and bureaucratic barriers, which are typical in post-communist and transition countries with sluggish institutional development (Pismennaya et al. 2017). Dermendzhieva (2011) voiced concerns about brain drain due to the difficulty of finding job opportunities in the South Caucasus countries, even if skilled workers have good chances of finding a job within domestic borders. In addition, the author mentioned that policy must focus on improving non-agricultural economic activities in rural areas, which aligns with the argument that the private sector's development is not at the desired level in the South Caucasus.

This paper's findings clarify that institutional progress in Azerbaijan is slow. This is not surprising if we consider the possible negative effects predicted by the natural resource curse, such as rent-seeking behavior, the non-overlapping interests of ruling elites with the society, the rentier state model that endangers long-term sustainable economic growth, and development, etc. Matveeva (2002) argued that, between 1991 and 2002, various problems were observed in Azerbaijan, such as low democratic values, press freedom, political turmoil, and the repression of non-governmental organizations. Guliyeva (2005) mentioned that legislative and constitutional reforms improved the overall situation regarding rule of law; however, the high concentration of power among executives created many barriers to the stable and positive development

of the latter following transitional issues, as well as economic and political instabilities, in Azerbaijan. Thus, the implementation of laws was not forceful enough to achieve the necessary checks and balances over centers of power.

In addition, this paper's findings show tha little or no significant improvement occurred over the past 20 years in Azerbaijan (except for government effectiveness) in terms of average growth rates of the institutional variables during the pre-and post-boom periods. While Georgia has demonstrated obvious improvements in institution-building and Armenia is also more or less progressing on this front, the situation in oil-rich Azerbaijan raises several questions about the adverse effects of the oil boom on institutional quality. Moreover, based on the results of the correlation analysis, the most relevant channels of the impact of the oil industry seems to be oil prices and oil revenue as they had the highest statistically significant correlation coefficients. However, the results remain mixed, because SOFAZ's share was also positively and statistically significantly correlated with institutional variables in Azerbaijan. Furthermore, measures such as oil rents and the mining-to-GDP ratio seem to be positively and significantly correlated with institutional variables. Here comes the difficulty of the specification of the exact effects of the oil industry on institutional quality and variables, because boom industries usually provide the positive multiplicative spillover effects too. However, according to Sadik-Zada et al. (2019), job creation remains low in the oil sector, while the processing industry is the only sector that has positively contributed to the rest of the economy. At the risk of oversimplification, this is likely why government effectiveness is the only index that showed noteworthy progress in Azerbaijan to manage oil-specific investments, revenue, etc. Thus, both statistically significant and insignificant correlation coefficients favor a negative correlation between oil industry-related variables and institutional variables, which supports the natural resource curse hypothesis that oil-rich countries may experience adverse effects and slower growth compared to resource-poor countries.

It has been mentioned in this paper that, in terms of the government effectiveness index, the situation in Azerbaijan is optimistic compared to Armenia. However, recent studies have focused on the efficiency and transparency of government spending, which raises the actuality of institutional development. For example, a study by Gumus and Mammadov (2019, 31) showed that "government expenditures in Azerbaijan may have problems indicating inefficient resource utilization," because the authors could not find any statistically significant relationship between real economic growth and government expenditures. Thus, despite periodic positive trends in the government effectiveness index, the economic aspects still fail to capture the proper results of this because the economic efficiency is still to be achieved. Malek (2006) argued that corruption, the misuse of public resources, and the ineffective fight against organized crime are common among state institutions in the South Caucasus as well as in Commonwealth of Independent States countries in general.

There are also other concerns. For example, even if the state fragility index improved in Azerbaijan during the boom and post-boom periods, the country's status is still classified under the "warning" status of the same index, which means that there is still room for crucial improvements (The Fund For Peace 2021). Thus, on the one hand, there have been improvements in inequality and conflict, and risk management in Azerbaijan since 2007, as measured by the state fragility and uneven economic

development indices. On the other hand, there are signs of institutional decline, as measured by the state legitimacy, human rights, and rule of law indices. These indices are highly correlated with each other, as a decline in one tends to lead to a decline in the others.

The results illustrate stark differences in civil liberties. The South Caucasian countries differ in terms of their civil society activities. Recent studies also support this idea. For instance, Georgia is believed to be active and well-organized, while Armenia is still undergoing a transformative process to enable civil society to play a role in political changes. However, Azerbaijan shows low promise due to the artificial hardships inhibiting foreign funding for the Non-government Organizations (NGOs) and the government's lack of interest in fast improvements in civil liberties (Luciani 2021).

The South Caucasus has a rich history of religion and cultural traditions that can be blended with the further development of the institutional quality as they are gaining new momentum in the social and political life of the region. For instance, religious institutions are the most trusted institutions after the army in Armenia and Georgia, while the third most trusted in Azerbaijan (Charles 2010). In fact, in all three South Caucasus countries, religion revived itself after independence from the USSR, increasing its public appearance and following the political imperatives (Jödicke 2014). However, the political agenda of the region's countries lack ideological foundations and proper politicians of the public requirements (Shirinov 2014). Meanwhile, the cultural traditions have been preserved in all three South Caucasian countries. For instance, the central role of family, its honor and name, hospitality, freedom, and courage are pivotal cultural elements among the South Caucasian countries (Coene 2009). Therefore, Caucasian culture and values must be at the center of attention when state-building or institution-building is concerned. The South Caucasus is still the region where the informal practice of social and public work is present, corruption is a challenge, and cultural pride is a survival tool (Coene 2009).

Sustainable and long-term economic development is the main concern for all countries in the South Caucasus. However, this can only be achieved in a peaceful and integrated environment, which has not been observed for long enough in the region (Korganashvili et al. 2017). Chronic security concerns between Azerbaijan and Armenia, as well as Georgia and the Abkhazia region, have diminished economic incentives to integrate with each other (De Waal 2012). Based on the findings of this paper, the following research question can be formulated and a follow-up study can be arranged: "What are the most pressing dimensions of the institutional reforms needed to achieve sustainable institutional and economic development in the South Caucasus to ensure regional integration and cooperation?"

5. Concluding Remarks

Numerous studies have demonstrated that institutional quality is necessary to achieve long-term and sustainable economic functions within a country. Institutional failures lead to other types of failures when economic agents cannot trust each other, do not cooperate with domestic or international actors in global value chains, and do not fulfill the demands of citizens. In this regard, the South Caucasus has witnessed colorful and

diverse political, institutional, and economic transformations since the collapse of the Soviet Union. Successfully weathering current changes and those that may occur during unstable and uncertain times depends on institutional quality. Governments must consider the far-reaching consequences of underdeveloped institutions and worsening trends in institutional quality.

This paper has shown that Georgia is a leader in overall institution-building, effective bureaucracy, and civil society promotion among the three South Caucasian countries, even if this trend is slowing and new challenges are emerging. The situation in Azerbaijan has challenged policymakers and decision makers to rethink measures of progress in institutional quality. Although much has been achieved since the 1990s in terms of GDP and GDP per capita growth in the South Caucasus, as a mineral-rich and boom-experienced country, tranquility based on oil revenue cannot sustain long-term economic prosperity in Azerbaijan. This paper shows that, compared to Georgia and Armenia, Azerbaijan lags in terms of institutional quality despite having better economic indicators. Moreover, internal factors (as measured by the increasing role of SOFAZ in the state budget) and external factors (as measured by oil prices) were negatively and significantly correlated with institutional quality (as measured by the control of corruption, rule of law, and government effectiveness indices) from 1996 to 2019.

Recovery in post-Soviet countries should not be solely measured through the main macroeconomic indicators but also regional comparisons of institutional change patterns. Better institutional quality ensures better recovery during times of crisis and decreases risks and uncertainties in integrated economies. The post-Soviet and post-transition periods must be supported by effective, sound, and inclusive institution-building to address the essential challenges of modern economic growth and development. The government's agenda must center not only on the development of new extractive industry projects, infrastructure enhancements, and diversification but also on institutional quality. Otherwise, the very main foundation of sustainable economic structure, according to institutionalism, of course, will be unstable irrespective of how much effort is being done in monetary terms.

Several limitations must be noted regarding the current study. First, measuring institutional quality is a difficult task, and the use of values from existing indices may not reflect realities in each country. This paper has mainly focused on the direction and evolution of main economic indicators and measures of institutional quality that mirror the political, social, and governance dynamics within a country. However, there are many country-specific factors related to institutional quality that remain untouched and lie outside the scope of this comparative work. Secondly, correlation analysis does not necessarily indicate a causal relationship between the variables of interest, and the results of such an analysis should not be interpreted in terms of the agreements between the variables (Schober et al. 2018). Rather, correlation analysis is limited to the calculation of correlation coefficients and significance, and solely correlation analysis is seldom in academic research. Usually, a regression analysis follows a correlation analysis to outline the relationship between the dependent and independent variable(s) (Goktay–Thatte 2017). While this paper does not draw any causal conclusions about the relationship between oil-related variables and institutional quality in Azerbaijan, its main purpose has been to comparatively assess the relevance of the impact of oil revenue on the economy. In other words, if the changes in the institutional quality and

oil-related variables occur jointly, there might be a solid presumption of the relevance of the natural resource curse theory in Azerbaijan's case. Therefore, the correlation analysis simply displays initial intuition for such an expectation, yet deficient to be decisive. Lastly, not only should governmental dynamics in institutional quality be analyzed, but societal change patterns should also be incorporated into the analysis via surveys to portray the other side of the institutional quality which is essentially about the citizens' perceptions, actions, and expectations. Future studies could examine citizens' reflections on institutional and political issues. To this end, the World Value Survey database would be useful.

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Does remittance spur economic growth? Evidence from post-socialist Armenia and Georgia

Ahmadov Vusal

Worker remittances are the second largest source of external finance for developing countries after FDIs, which has increased interest in measuring their effect on economic growth in underdeveloped economies. In this study, I analyze the causal relationship between remittances and economic growth in two post-socialist countries - Armenia and Georgia, which experienced significant emigration after the collapse of socialism. To minimize endogeneity problems, I employ POLS (pooled ordinary least squares) and FE (fixed effects) estimations in assessing the effects of remittance on economic growth. Data set covers the 1997-2019 period. Results show that remittances have a positive effect on economic growth in these small post-socialist economies.

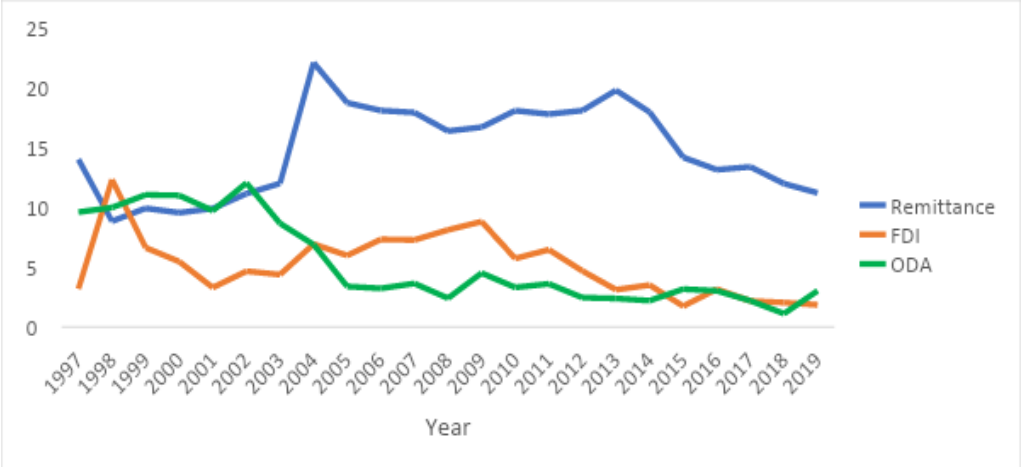
Key words: Armenia, Georgia, remittance, economic growth, POLS, fixed-effect

1. Introduction

The rise of neoliberalism eased factor movements across borders, which resulted in an unprecedented hike in worker remittances. It increased from $68.44 billion in 1990 to $656 billion in 2019 of which $551 billion was received by developing countries (WB 2019). Regarding the significant amount of remittances via informal channels, official statistics underestimate their real volume. Nonetheless, remittances are the second largest source of foreign capital after FDI for developing countries and their volume is significantly higher than foreign aid (Ratha 2005). FDIs are sensitive to the macroeconomic environment and cease when there is deterioration in the host economy. In contrast, remittances are a stable and more reliable source of foreign capital. Low-income countries such as Lesotho, Kyrgyzstan, and Tajikistan are heavily dependent on remittances and their share in GDP ranges between 20–40 percent. In general, the majority of developing countries receive remittances at more than 5 percent of their GDP (Salahuddin–Gow 2015).

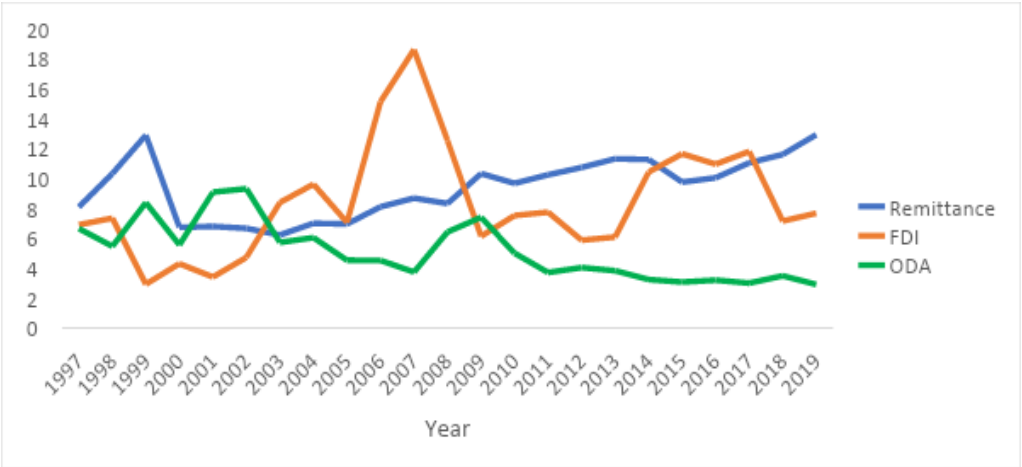
Armenia and Georgia, two small, post-socialist economies, can also be considered as reliant on remittances. The dismantling of the USSR resulted in collapse of production, trade, and financial links among member states and badly hurt these underdeveloped small economies. In contrast to the guaranteed employment of the socialist period, employment and decent income is extremely scarce in the new era. As a result, massive labor migration began in the mid-90s. Despite all of this, their economic performance revived after the transition shock, although labor migration persisted due to lack of job opportunity. Logically, labor migration is accompanied by remittances. Figures 1A and B illustrate that remittances are the main source of foreign currency for these countries despite it sometimes being replaced by FDI in Georgia.

Figure 1A Inflows to Armenia (% of GDP) 1997-2019



Source: World Bank Development Indicators

Figure 1B Inflows to Georgia (% of GDP) 1997-2019



ODA-Official development Assistance
Source: World Bank Development Indicators

Continuous inflows of remittances raise scholarly and policy-maker interest on the impact of remittances on the economy of receiving countries. There is no unanimity among scholars on the impact of remittance on receiving economies. One line emphasizes that remittances can provide macroeconomic stability, have a multiplier effect on aggregate demand via higher consumption, provide capital in a dearth of savings, and finance spending on human capital (Barajas et al. (2009)). Others highlight that remittances may discourage labor force participation, and hamper the export sector via appreciation of domestic currency (Chami et al. 2008). Studies on the influence of remittances on the economic performance of the two South Caucasian countries are scarce while there is voluminous research on this topic. In this paper, I aim to evaluate

the effects of remittances on the economic growth of Armenia and Georgia and seek answer to the question of the effect of remittances on the economic performance of these Caucasian countries. I hypothesize that remittances positively contribute to economic growth in Armenia and Georgia. I test this hypothesis by employing panel regression analysis.

In the next section, I review existing literature on remittance and economic performance relationships. Section 3 presents data and methodology. I discuss the results in the 4th section and draw conclusions in the last section.

2. Literature review

Studies on the effect of remittances on economic growth deduce both positive and negative effects. The optimistic view claims remittances can reduce country risk, enhance creditworthiness of a country for external borrowing (Chami et al. 2008), reduce macroeconomic instability (Barajas et al. 2009), increase capital stock, promote financial stability by reducing risk of current account reversal (Bugamelli 2009), and improve balance of payments (Acosta et al. 2007). Durand et al. (1996) investigate the effect of remittance on the economic development of Mexico and summarize that remittance-led consumption can employ idle production factors and resources and have a multiplier effect on the domestic economy. Barajas et al. (2009) and Azizi (2018) claim that remittance has a positive effect on human capital accumulation. Furthermore, remittances allow receivers to stay in education longer.

Mossey et al. (1998) conclude that remittance is a source of start-up capital in West-Central Mexico. Woodruf and Zenteno (2001) come to a similar conclusion that remittances are responsible for 20 percent of capital in micro-business in urban Mexico. In contrast, remittances are mainly consumed in MENA countries and don't impact on investment (Mi and Ali 2012). Chami et al. (2003) indicate that remittances mainly go to consumption, a small portion is invested in unproductive housing, land, and jewelry. In countries with primitive financial systems, remittances can contribute to economic development by providing alternative channels to finance investment and overcome liquidity constraints for small business (Giuliano–Ruiz-Arranz 2009). Similarly, a developed financial market has the potential to allocate remittance to productive investment through sophisticated financial systems. Contrastingly, intermediate level of financial development is not effective to channel remittance to investment (Catrinescu 2009).

Aggarwal et al. (2011) find positive association between remittances and bank deposits and credit development. By analyzing the effect of remittances on financial development in post-socialist Central Eastern Europe (CEE), Former Soviet Union (FSU) and Mongolia, Kakhkhorov and Rohde (2020) show that remittances have positive effects especially via credit-related indicators. Remittances help to improve the creditworthiness of borrowers. Chami et al. (2003) assert that by relaxing capital constraint on borrowers, remittances hinder capital market development through reducing demand for its products.

Catrinescu et al. (2009) point out that better economic and political institutions allow the exploitation of the potential benefits of remittances on economic growth. By analyzing 116 countries for 1990-2014, Matuzeviciute and Butkus (2016) conclude that

remittances are effective in promoting economic growth in relatively developed countries compared to underdeveloped ones, while the growth effect of remittances diminishes as their abundance increases.

Acosta et al. (2007) analyze the effect of remittances on the tradable sector of emerging economies in the context of El-Salvador. They claim that remittances result in a fall in labor supply and increase in consumption of non-tradables at the cost of the tradable sector. Regarding labor intensity of the non-tradable sector, increased demand leads to a rise in price of non-tradables. Higher non-tradable prices incentivize its further expansion, which reallocates labor resources from the tradable sector. Losing the competitiveness of the tradable sector via exogenous expansion of the non-tradable sector is called the "Dutch disease" phenomena (Corden 1984). Chami et al. (2008) and Guha (2013) come to a similar conclusion that remittance can hamper the competitiveness of the tradable sector by allocation resources from this sector to non-tradable production. Amuedo-Dorantes and Pozo (2004) assert that remittances appreciate real exchange rates in 13 Latin American Caribbean countries. Considering the persistence of high unemployment rates in developing countries, demand for non-tradables may not undermine the effectiveness of exports by shifting its labor resources (McKinley 2005). Acosto et al. (2009) propose that sophisticated financial markets can channel remittances to productive investment, and therefore, mitigate their negative effect on the appreciation of domestic currency.

Remittances have the potential to create incentives which are detrimental to economic growth. Mansoor and Quillin (2006) indicate that remittance can make receivers rely on it as a source of income. At the same time, it can raise receivers' reservation wages. Both together can reduce labor supply in the domestic economy. According to Shera and Meyer (2013), as remittances provide an income source for citizens, society is not eager to pressure the government to implement economic reforms. Inflows of remittance as foreign currency may make the government overoptimistic and weaken its fiscal discipline (Barajas et al. (2009), Barajas et al. (2012)).

After the collapse of the communist bloc, the economic situation in individual countries, especially in the FSU countries triggered considerable labor migration, which was accompanied by cross-border remittances. In this regard, considerable research has been done on the effect of remittances on economic growth in post-socialist countries. Leon-Ledesma and Piracha (2004) analyze the effects of remittances on economies of CEE countries and conclude that remittances have positive effects both on employment and productivity via increase in investment. Meyer and Shera (2017) investigate the impact of remittances on the 6 top remittance-receiving countries of transition economies in Europe, and indicate the positive effect of remittances on economic growth of these countries. Bayar (2015) examines the influence of remittances on economic growth in EU transition economies in tandem with FDIs. He concludes that remittances positively contribute to economic growth by increasing national savings and foreign exchange reserves. According to Abduvaliev and Bustillo (2019), remittances have a positive and significant effect on economic growth in CIS countries. Martin et al. (2002) relate the success of Albanian economy in the mid-90s to significant inflows of remittances.

Regarding the specificity of small developing economies and the relatively high share of remittances in many of these countries, it is important to present studies on the

impact of remittances on these countries. Ahortor and Adenutsi (2008) investigate the effect of remittance on the long-run economic growth of small-open developing economies in Latin America (LA), the Caribbean, and Sub-Saharan Africa (SSA), and conclude that the effect is strong especially in LA. Feeny and Iamsiraroj (2014) analyze the influence of remittances on the economic growth of small island developing countries (SIDC) in comparison with other developing countries. They conclude that influence is strong in SIDCs, while it is negligible in other developing economies. Their findings contradict those of Ahortor and Adenutsi` (2008), that the effect of remittance is weak in LA but strong in SSA. Benhamou and Cassin (2021) come to the conclusion that remittances increase expenditure on education in small economies.

Studies on relations between remittance and economic growth are scarce for Armenia and Georgia. Dilanchiev and Sekreter (2016) measure the effect of remittances on economic growth in Georgia by employing the Johansen Cointegration test and find positive impact. Kakulia (2007) claims that remittances are mainly spent on consumption and boost the trade sector in Georgia. Gerber and Torosyan (2013) propose that remittances do not contribute to unemployment in Georgia. Remittances have a positive effect on human capital accumulation and ease access to loans for small businesses. Horojan (2015) concludes that remittances have a positive impact on the Armenian economy in interaction with financial deepening and improvement of institutional quality.

3. Data

This section gives the description of data on remittances, economic growth, and control variables deployed in growth regression. Remittance is an explanatory variable of my regression. There are various sources for personal remittances. One frequently used one is the IMF Balance of Payment Statistics Yearbook, which indicates remittances in workers' remittances, migrant transfer, and compensation of employee items. The World Bank (WB) aggregates them under the heading of remittances. I use the remittance per capita indicator. I divide annual personal remittances received (current USD) by the population for Armenia and Georgia in respective years. The dependent variable of regression is economic growth, which is expressed as GDP per capita in current USD

The following are control variables of my regression. *Investment* (*inv*) is calculated as the share of gross capital formation in GDP. *Foreign Direct Investment* (***fdi***) is defined as the ratio of FDI inflows to GDP. I use two indicators for assessing financial development. First is *Broad Money* (***bm***) to GDP ratio defined as the proportion of M2 to GDP. The second indicator is the ratio of loans for the private sector to GDP. *School enrollment* (**se**) ratio measures tertiary enrollment and stands for human capital. *Trade openness* (***to***) is defined as the ratio of sum of exports and imports to GDP. I conducted differentiated logarithmic of all independent, dependent, and control data to account for stationarity and other estimation issues. I use annual data, and data sources for all variables are from WB Development Indicators for the period of 1997 and 2019.

4. Model estimation

The following equation estimates the effect of remittances on economic growth in Armenia and Georgia.

$$GDP_{it} = \sum\beta_0 + \beta_1 R_{i,t} + \beta_i X_{it} + \eta_i + \varepsilon_{it}$$

GDP_{it} is GDP per capita, R_{it} is remittance per capita, X_{it} are control variables mentioned in the previous section, η_i is unobserved country-specific effect, and ε_{it} is error term. β_0 is constant, β_1 is the elasticity of GDP per capita to remittances per capita, and βi stands for i^{th} control variable.

Regarding the possibility of both positive and negative effects of remittances on domestic economy as mentioned in Section 2, the expected sign of coefficient correlated with remittances is equivocal. Considering control variables, investment has an estimated positive effect on economic growth (Long–Summers 1991). FDI inflows can spur economic growth via transfer of technology; however, the host country must have absorptive capacity (Borenzstein et al. 1998). Therefore, its estimated sign is unclear. The effect of financial development in the expression of enlargement of money supply and commercial loans on economic growth in developing countries is ambiguous. From one side they can provide liquidity and capital, from another side they can increase exposure to financial crises (Miller 1998, Dawson 2008). The expected sign of tertiary school enrollment as a measure of human capital development is positive (Barro 2001). Trade openness in remark of trade volume has a positive effect on economic growth (Yanikkaya 2003).

5. Empirical results

Before presenting the results of the regression model, I will introduce descriptive statistics and a diagnostic test to check OLS assumptions. Table 2 exhibits descriptive statistics. In order to test stationarity of the dataset, I applied the Unit Root Test (Table 3). Considering the shortness of my time series, the most appropriate tests are the Dickey-Fuller and Phillips-Perron tests (Arltova–Federova 2016). Excepting minor violation of stationarity criterion ($p<0.05$) in trended probability of GDP and private loans, all data satisfy the requirement of stationarity.

Table 2 Descriptive Statistics

	DIF_GDP	DIF_REMP	DIF_INV	DIF_FDI	DIF_SE	DIF_BM	DIF_TO
Mean	0.089554	0.095126	0.005384	–0.009907	0.027713	0.079153	0.020861
Median	0.083289	0.101530	0.014724	0.031993	0.044249	0.071215	0.036842
Maximum	0.374722	0.857293	0.325573	1.350276	0.390387	0.282706	0.136419
Minimum	–0.292181	–0.542883	–0.338108	–0.918336	–0.297073	–0.105764	–0.139128
Std. Dev.	0.139837	0.226793	0.137737	0.430409	0.103200	0.091957	0.065276
Skewness	–0.538537	0.015271	–0.111225	0.478765	–0.025660	0.106300	–0.551294
Kurtosis	3.579649	5.717171	3.232616	3.993412	6.845203	2.989681	2.627952
Jarque-Bera	2.742819	13.53724	0.189923	3.490172	27.11174	0.083060	2.482556
Probability	0.253749	0.001149	0.909408	0.174630	0.000001	0.959320	0.289015
Sum	3.940357	4.185540	0.236900	–0.435900	1.219353	3.482732	0.917894
Sum Sq. Dev.	0.840843	2.211708	0.815769	7.965833	0.457961	0.363611	0.183224
Observations	44	44	44	44	44	44	44

Source: Author's calculations

Table 3A Unit Root Test (Dickey-Fuller)

	At level	dif_gdp	dif_remp	dif_inv	dif_bm	dif_pl	dif_se	dif_to
With Constant	t-Statistics	12.8262	15.3257	20.0712	40.3464	11.5107	33.6294	18.1409
	Probability	0.0122	0.0041	0.0005	0.0000	0.0214	0.0000	0.0012
With Constant &Trend	t-Statistics	8.37234	12.1892	16.9136	38.3436	6.71784	26.7942	13.1544
	Probability	0.0789	0.0160	0.0020	0.0000	0.1516	0.0000	0.0105
Without Constant &Trend	t-Statistics	17.3253	22.1455	32.0030	14.4100	16.7622	44.8469	22.0874
	Probability	0.0017	0.0002	0.0000	0.0061	0.0021	0.0000	0.0002

Source: Author's calculations

Table 3B Unit Root Test (Phillips-Perron)

		dif_gdp	dif_remp	dif_inv	dif_bm	dif_pl	dif_se	dif_to
With Constant	t-Statistics	12.8838	15.3257	20.4057	42.9792	11.4198	33.2752	18.1207
	Probability	0.0119	0.0041	0.0004	0.0000	0.0222	0.0000	0.0012
With Constant &Trend	t-Statistics	8.04256	12.5226	17.3606	143.374	6.64041	25.7535	13.2212
	Probability	0.0900	0.0139	0.0016	0.0000	0.1562	0.0000	0.0102
Without Constant &Trend	t-Statistics	17.2552	22.2458	32.3988	27.5352	16.5454	43.5489	22.3310
	Probability	0.0017	0.0002	0.0000	0.0000	0.0024	0.0000	0.0002

Source: Author's calculations

The similarity of the level of the economic development and structure of the Armenian and Georgian economies justifies the employment of Panel regression. I employ both Pooled Ordinary Least Squares (POLS) and Fixed Effect (FE) estimation models and use E-views 10 as a software package. The POLS estimation does not take country specific features into account, which can have relations with explanatory variables. It pools all variables and recognizes them as data for a single "united" country. The FE model estimates the explanatory variable as non-random. Fixed effect estimation "clears" regressor from unobservable country-specific effects. In other words, it neutralizes correlation between country-specific error terms and explanatory variables.

I ran residual diagnostics for testing the validity of the model. The Serial Correlation test shows the p-value to be higher than 5 percent, and therefore, residuals are not serially correlated. Therefore, the model is valid to explain relations among interested variables.

Table 4 presents results of equation by using POLS and FE estimation. Results of both estimations are similar. The result shows that the relationship between GDP growth and remittances is positive, a one percent increase in remittances can raise GDP per capita in Armenia and Georgia by 0.36 percent on average. Remittance is only statistically significant among independent variables.

Both investment and FDI indicate positive association with GDP per capita, despite this coefficient being tiny. One of the possible explanations for the negligible effect of FDIs on economic growth lies in features of FDIs. The effects of market-seeking and partially resource-seeking FDIs on host economies are limited and exhaust rapidly (Dunning 2015). Considering the underdeveloped structure of the Armenian and Georgian economy, these strategies probably dominate the choice of foreign capital.

Broad money supply has a negative association with GDP per capita, while loan to private sector displays a small positive correlation. Qualitative evaluation of financial development such as the effectiveness of the financial system to allocate resources to

productive investment can present a better understanding of their effect on economic growth in Georgia and Armenia.

The GDP per capita and tertiary school enrollment show positive relations, which is congruent with theory. Contrary to expectation, trade openness negatively contributes to economic growth. As Ulasan (2015) suggests, trade openness by itself cannot promote economic growth. The specialization of a country in international trade and the role of the government to upgrade its position in international specialization are decisive factors for benefiting from trade openness. Considering the underdeveloped structure of the Armenian and Georgian economies, trade openness cannot alone boost their economy.

The answer to the question of through which channels remittances can affect economic growth in Armenia and Georgia is ambiguous. Nevertheless, the first possible direct effect can be a rise in domestic demand via remittance-supported consumption. The increased demand for consumed goods and services can lead to deployment of idle production factors. Considering the massive job loss after transition shock, this channel can involve some part of the idle labor force in employment.

By enabling acquiring education for young members of receiving families, remittances can contribute to economic growth via enhancement of human capital of Armenia and Georgia. Nonetheless, insufficiency of demand for skilled labor force and low level of payment for their work in labor markets can result in more emigration and prolonged dependence of the domestic economy on remittances in these countries.

Lastly, the positive effect of remittance on the economies of Armenia and Georgia can apply by supporting macroeconomic stability which is necessary for investment. Excepting output contraction corresponding to the global financial crisis (additionally, the Russian military attack on Georgia), these countries haven't experienced macroeconomic instability after the transition shock of early 90s. It is obvious that remittances are not the sole reason for macroeconomic stability in the above-mentioned period but their contributions are undeniable.

Table 4 Dependent variable GDP per capita

Ind. variables	OLS	Fixed Effect
Constant	0.048573	0.048104
diff_remp	0.363672	0.362787
diff_inv	0.066477	0.078226
diff_fdi	0.065803	0.068932
diff_bm	–0.119800	–0.120136
diff_pl	0.087325	0.090436
diff_se	0.275359	0.252682
diff_to	–0.057304	–0.017551

R-squared	0.506466	Mean dependent var	0.089554
Adjusted R-squared	0.410502	S.D. dependent var	0.139837
S.E. of regression	0.107365	Akaike info criterion	–1.462191
Sum squared resid	0.414984	Schwarz criterion	–1.137792
Log likelihood	40.16819	Hannan-Quinn criter.	–1.341888
F-statistic	5.277625	Durbin-Watson stat	1.900051
Prob(F-statistic)	0.000326		

Source: Author's calculations

Table 5 Diagnostic Test (Cross-sectional Dependence Test)

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	1.556113	1	0.2122
Pesaran scaled LM	0.393231		0.6941
Bias-corrected scaled LM	0.345612		0.7296
Pesaran CD	1.247442		0.2122

Source: Author's calculations

6. CONCLUSION

In this study, I measured the effect of remittances on the economic growth of Armenia and Georgia. The study revealed a positive and significant effect of remittances on economic growth in these countries. Despite the fact that remittances have a significant effect on the overall economy, they should not be accepted as a determinant of economic development. Firstly, remittances can increase domestic demand but cannot in themselves upgrade production capacity, which is necessary for long-run economic growth. Secondly, reliance on remittances can result in neglecting necessary institutional reforms and implication of government policies which are necessary for the investment environment. The Armenian and Georgian governments should have a development strategy and find more effective ways of channeling remittances into human and physical capital accumulation.

This paper analyzed the effect remittances have on economic growth in post-socialist Armenia and Georgia. Nonetheless, it remains necessary to investigate the channels by which remittances affect economic growth.

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Macroeconomic policy empirical analysis using an unrestricted standard VAR Model: The case of Mongolia

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Abstract. This paper is mainly about key fiscal policy indicators and their interrelations between each other. The model that is used in the analysis is the Vector Autoregressive Model. There are seven variables selected: GDP, Money Supply, Government Revenue, Government Expenditure, Export, Government Debt, and Global Copper Price. Besides VAR estimation, IRFs are computed to define how variables react to certain shocks. The key finding of the research is that both GDP and government revenue are sensitive to copper price changes and the resulting shock. Copper Price is an effective tool to predict these two variables in the short-run. Government Revenue is an effective tool to impact export in the short-run. Government Debt is not an effective indicator to affect any variables except Government Expenditure. Money Supply is only effective for GDP. Government Expenditure is also not significantly effective in having an impact on other variables, but is weakly affected by Government Revenue, Copper Price, and Export. Most variables considered in the research belong to fiscal policy, thus, effective fiscal policy can be implemented using the results of this paper.

Keywords: VAR model, IRFs, macroeconomic policy, variables, shocks

1. Introduction

Mongolia has a small open economy and its natural resources include copper, gold, coal, and a small amount of raw oil. These are the current mainstays of the whole economy. The key challenge of policy in Mongolia is to strengthen the resource price-susceptible economy and transform natural resources into a substantial asset with long-term sustainable development (Avralt-Od et al. 2012).

The conditions that Mongolia faces so far have been low copper prices, high levels of debt, shortage of government revenue, and depreciation of the national currency. Some of these important macroeconomic indicators are carried out through macroeconomic policies, fiscal, and monetary policies. Thus, it is important to learn the dynamics of those main macroeconomic indicators, their impact on the economy, and their responses to specific shocks.

The main goal of this research paper is to research how key economic indicators relate with each other and to examine if there is any causal relationship between those indicators. Furthermore, the paper wishes to contribute to the policy decision making. Within the scope of the research paper, we hypothesized that external debt has a direct negative effect on GDP, government spending has a positive effect on GDP, and the GDP of Mongolia is sensitive to global copper price shock. The paper also aims to provide an answer to the following research questions:

- How does the economy respond to certain macroeconomic shocks?
- Is there any causal relationship between the key economic indicators considered in this paper?

This paper is organized as follows: Section 2 provides an overview of the economy of Mongolia, Section 3 discusses related studies completed in several different countries, Section 4 presents the data, Section 5 reviews the methodology, Section 6 presents the result, and the final section, Section 7, concludes the paper.

2. Overview of Economy of Mongolia

The Global Financial Crisis of 2008 brought great volatility to the Mongolian economy. The sharp drop in the copper price (US $7850-$3000 per ton) and the Chinese economy slow-down led not only copper production but also total production in Mongolia falling to one third of previous levels. During this period, the government needed to increase its expenditure to stimulate the economy, however, it was difficult for the government to cover this increase given its decreasing revenue. The government of Mongolia had to borrow more money and had no option but to choose pro-cyclical policy during this recession phase (Batpurev–Munkhsoyol 2013, Doojav–Batmunkh 2018, Bayarsaikhan et al. 2016).

Because there were problems of high government expenditure, low copper prices on the global market, delays in mining activity, depreciating exchange rate, and declining currency reserve, the government of Mongolia had to accept 3-year IMF - Extended Fund Facility Program in May 2017. Mongolia is expected to receive about US $5.5 billion in total from IMF and some other financial partners (IMF, 2017).

Li et al. (2017) identified that there were three main difficulties to reaching sustainable growth by using its resource in the long-run for Mongolia, which are the lack of export diversification, weak policy mix, and inefficiency of investment in weak project selection and implementation. When the global market price of commodities went up from 2004, Mongolia benefitted from this rise and total budget revenue increased dramatically. High copper prices brought Mongolia high levels of income and high economic growth. During this time, the Mongolian government conducted an expansionary fiscal policy (Batchuluun et al. 2012). However, all other non-resource export sectors suffered harm from this situation, because human resources, wage rises, the whole economy shifted to the mining industry and the whole country started depending on the development of natural resources. Avralt-Od et al. (2012) also stated that Mongolia was prone to exposure to a negative commodity price shock and external negative shock relevant to natural resources.

Maino et al. (2013) also note that increasing government spending leads to a high risk of macroeconomic instability. According to the budget balance provided by the Ministry of Finance, Mongolia started experiencing significant fiscal deficit from December 2008 and since then, there has been a constant fiscal deficit. (Chuluunbat 2015) Besides external shocks, government expenditure and off-budget expenditure were much higher than the budget income. Based on data from NSO and the Ministry of Finance, government spending as a share of GDP is around 30 percent (Mongolia, Ministry of Finance of Mongolia, 2019).

3. Literature review

Gogas and Pragidis (2013) define that positive government spending shock has no impact on real output or its growth and a negative government spending shock is also not significantly based on low coefficient. Afonso-Sousa (2008) use Bayesian Structural VAR model and indicates that government expenditure shocks have a small effect on GDP and lead to the "crowding-out" effect. It is also noted in the paper that government debt dynamics should be considered. In the paper of Rahman, (2005), it is concluded that monetary policy was more effective on real output growth than fiscal policy based on the unrestricted VAR approach in Bangladesh. Lütkepohl and Krätzig (2004) define VDC as the variability contribution of independent variable X to the h-step forecast error variance of dependent variable Y. This contribution is mostly estimated as a percentage. In the case of Colombia, Vargas-Herrera et al. (2012) find that fiscal expenditure has a greater impact on output and conclude that a reduced ratio of debt-to-GDP decreases the probability of risk of default by the Colombian government and reduces vulnerability to revenue and expense shocks.

In 2017, the Natural Resource Governance Institute published Macro-Fiscal modeling of Mongolia, which concludes that the real growth rate of total GDP will accelerate gradually in the near future and stabilize from 2024. Because of increasing expenditures, the level of debt to GDP ratio is increasing continuously. The economy is fragile to negative shocks, for example, commodity price shocks and delays of mining (Baksa et al. 2017). Li et al. (2017) conclude that a less aggressive investment path would perhaps be better for the country's debt sustainability. Doojav (2018) shows that exchange rate depreciation has a positive effect on macroeconomics, especially on the trade balance of Mongolia in the long-run. The presence of natural resources has a solid impact on the exchange rate, which plays an important role in export and import. Batpurev and Munkhsoyol (2013) find that on goods and service market, budget expenditure has the effect of increasing household consumption dramatically in the short-term and decreasing private investment to a lesser extent.

Based on the research of the impact of monetary and macroprudential policy in a commodity exporting economy in Mongolia, Doojav and Batmunkh (2018) address the key challenges of monetary and fiscal policy of Mongolia and notes external and government spending shocks are vital to business cycle fluctuations. Maino et al. (2013) also address the fact that expansionary fiscal policy, and a rise of credit activity associated commodity boom, leads to increasing price volatility on the asset market and a significant rise in the risk of financial instability. Bayarsaikhan et al. (2016) conclude that a bank lending channel is quite strong in Mongolia compared to other channels, so monetary policy should place more attention on bank lending activities.

As for resource-rich countries, because there was high volatility in prices of natural resource, it leads to significant volatility in output (Ploeg–Poelhekke 2009). Therefore, long-run growth can be negatively affected by unexpected changes. Ploeg (2011) indicated that less openness to foreign trade and foreign direct investment caused resource wealth. Birdsall and Hamoudi (2002) note that most resource-dependent developing countries benefit from export duties, and least benefit from tariffs. Sachs and Warner, (1995) are among the first researchers who discussed the natural resource curse across 97 countries data, mainly referred to as Dutch disease effect. Butkiewicz

and Yanikkaya, (2010) mentioned the several explanations of the resource curse, for instance, the Dutch disease, rent seeking and corruption which result in inadequate institutions, debt overhang, and low investment on human capital. Manzano and Rigobon (2001) propose resource rich countries will be disadvantaged with extensive borrowing and a decline in trade. Based on a research paper by BOM, (Avralt-Od.P, et al., 2012), they present that in Mongolia, resource transmission effect is quite high regarding money flow in the mining sector.

4. Data

The main macroeconomic variables which are used in the research are Gross Domestic Product, Money Supply, Total Government Revenue, Government Spending, Export, Government External Debt, and Global Copper Price.

The sources from which the data is collected are the National Statistical Office (NSO), Ministry of Finance (MOF), Bank of Mongolia (BOM), FRED in St. Louis, and General Customs Administration (GCA). The range of data of variables covers the first quarter of 2000 to the fourth quarter of 2018, in total 76 observations for each variable. In the case of data manipulation, the quarterly average exchange rate is used for the calculation (see Table 1).

Table 1 Data Description.

	Variables	Range of Data	Description	Sources
1	GDP	2000Q1-2018Q4	(GDP)	NSO
2	Money supply	2000Q1-2018Q4	(M2)	BOM
3	Government revenue	2000Q1-2018Q4	Total budget income (GREV)	MOF
4	Government expenditure	2000Q1-2018Q4	Budget expenditure on goods and services (GEXP)	MOF
5	Export	2000Q1-2018Q4	Foreign Trade Balance (EXP)	NSO and CGA
6	Government external debt	2000Q1-2018Q4	Total government external debt (GDEB)	BOM
7	Global copper price	2000Q1-2018Q4	Global copper price per metric ton (COPP)	FRED in St. Louis
8	Exchange rate	2000Q1-2018Q4	Quarterly average exchange rate	BOM

Source: Author's interpretation.

For us, it is important to study how GDP moves up and down and how it responds to certain changes of variables in the economy. As Acemoglu et al. (2016) show, total

government spending in research covers government purchase of goods and services and does not include bond interest payments, social transfers, or subsidies. In addition, because it is considered a resource-rich economy, export is taken as one of the variables.

The seasonality of the data is cleared by using X-12-ARIMA seasonal adjustment package. Unadjusted data might have a possibility of encountering misspecification, in particular, it can neglect other frequencies because of putting a large focus on fitting the seasonality (Neusser, 2016). Exchange rate is used for the transformation of US Dollars into local currency. In addition, the natural logarithm form of data is considered.

5. Methodology

The model to be used in the paper is the Vector Autoregressive model, especially standard unrestricted VAR model. Vector autoregressive model is helpful to capture the joint dynamics of various time-series (Miranda-Agrippino and Ricco 2018). VARs are mostly used by scholars and policymakers to perform a structural and scenario analysis and to make a forecast. The model was first introduced by Sims (1980), where he estimated a six-variable dynamic system with no theoretical perspectives. Because of its appliances in real cases, more accurate forecasting results, and there is less complexity to apply, so unrestricted VAR model is used in this research. Through the VAR model, specifically, through the Granger causality test, it gives the possibility to see what causes which variable (Koop, 2008).

VAR model that is used in the analysis consists of 5 endogenous variables and 2 exogenous variables. According to residual diagnostics, two variables are better to be concerned as exogenous. The optimal lag of the model is 2-lags. To this end, the system of the VAR model used in the analysis as follows.

Equation 1 VAR(5) model.

$$\begin{bmatrix} GDP \\ GREV \\ GEXP \\ EXP \\ COPP \end{bmatrix} = \begin{bmatrix} C_{1,11} \\ C_{2,11} \\ C_{3,11} \\ C_{4,11} \\ C_{5,11} \end{bmatrix} + \begin{bmatrix} C_{1,1} & C_{1,2} \\ C_{2,1} & C_{2,2} \\ C_{3,1} & C_{3,2} \\ C_{4,1} & C_{4,2} \\ C_{5,1} & C_{5,2} \end{bmatrix} * \begin{bmatrix} GDP_{(-1)} \\ GDP_{(-2)} \end{bmatrix} + \begin{bmatrix} C_{1,3} & C_{1,4} \\ C_{2,3} & C_{2,4} \\ C_{3,3} & C_{3,4} \\ C_{4,3} & C_{4,4} \\ C_{5,3} & C_{5,4} \end{bmatrix} *$$

$$* \begin{bmatrix} GREV_{(-1)} \\ GREV_{(-2)} \end{bmatrix} + \begin{bmatrix} C_{1,5} & C_{1,6} \\ C_{2,5} & C_{2,6} \\ C_{3,5} & C_{3,6} \\ C_{4,5} & C_{4,6} \\ C_{5,5} & C_{5,6} \end{bmatrix} * \begin{bmatrix} GEXP_{(-1)} \\ GEXP_{(-2)} \end{bmatrix} + \begin{bmatrix} C_{1,7} & C_{1,8} \\ C_{2,7} & C_{2,8} \\ C_{3,7} & C_{3,8} \\ C_{4,7} & C_{4,8} \\ C_{5,7} & C_{5,8} \end{bmatrix} * \begin{bmatrix} EXP_{(-1)} \\ EXP_{(-2)} \end{bmatrix}$$

$$+ \begin{bmatrix} C_{1,9} & C_{1,10} \\ C_{2,9} & C_{2,10} \\ C_{3,9} & C_{3,10} \\ C_{4,9} & C_{4,10} \\ C_{5,9} & C_{5,10} \end{bmatrix} * \begin{bmatrix} COPP_{(-1)} \\ COPP_{(-2)} \end{bmatrix} + \begin{bmatrix} C_{1,12} \\ C_{2,12} \\ C_{3,12} \\ C_{4,12} \\ C_{5,12} \end{bmatrix} * [M2] + \begin{bmatrix} C_{1,13} \\ C_{2,13} \\ C_{3,13} \\ C_{4,13} \\ C_{5,13} \end{bmatrix} * [GDEB] \quad (2)$$

6. Results

The research follows two fundamental steps which are VAR estimation, and impulse response functions. In general, VAR model tells if the economic indicators are significantly related to each other, while impulse response function shows how these indicators respond to shocks (Hill et al. 2008). The econometric package that is used in the estimation is Eviews 6.

6.1. VAR Estimation

Within the range of the VAR estimation, the following tests are performed.

- Stationary test and Cointegration test
- Optimal Lag length selection
- Estimation of VAR
- Residual diagnostics
- Granger Causality test

In order to run a VAR model, we first run the stationarity test through the ADF test. In ADF test, Schwarz Information Criteria is used. Because some variables show a trend over time, stationarity is tested through both with and without a trend. T-statistics results of ADF test are compared to the critical values of the Dickey-Fuller unit root t-test statistics table at the significance level of 5 percent. The absolute values of t-statistics are smaller than the absolute value of critical values at a level of 5 percent significance, thus it is failed to reject the null hypothesis, which means an individual variable has a unit root. Based on the result of the ADF test, it is possible to proceed with the analysis without the trend. The variables give an insignificant coefficient for time trend, except export, and government revenue at a 5 percent significance level. For this reason, the time trend is not considered in the further analysis.

Once it is defined that chosen variables are not stationary, cointegrations among variables are tested. According to the first step of the Engle–Granger Two-Step cointegration approach, I run a co-integration test. Cointegration equation follows Ordinary Least Square in the estimation (see Table 2).

Table 2 Cointegration test result.

GDP = β0 + β 1*M2 + β 3*GREV + β 4*GEXP + β 5*EXP + β 6*GDEB + β 7*COPP + ε						
GDP=0.38 + 0.32*M2 +0.49*GREV – 0.03*GEXP + 0.20*EXP – 0.01*GDEB – 0.18*COPP						
(0.17)	(0.07)	(0.09)	(0.08)	(0.06)	(0.04)	(0.06)
R2 = 0.9876	N = 76					

Source: Author's estimation.

Residual is defined as follows. The result of the ADF test of residual is given in Table 3.

RES = GDP – β0 – β 1 *M2 – β 3*GREV – β 4*GEXP – β 5*EXP – β 6*GDEB – β 7*COPP
RES = GDP–0.38–0.32*M2–0.49*GREV+0.03*GEXP–0.20*EXP + 0.01*GDEB +
+ 0.18 *COPP

Source: Author's estimation.

Table 3 Residual ADF Test result.

Variables	t-statistics	p-value	1%	5%	10%
RES	−4.270253	0.0010	−5.51233	−4.97684	−4.69648

Source: Author's estimation.

Residual is also tested through the ADF unit root test if it is stationary. The t-statistics result is reliable and it gives certain information whether the zero is accepted or not. In this case, Davidson and MacKinnon (1993) critical value table is used (MacKinnon, 2010). According to the result, t-statistics is smaller than 1 percent, 5 percent, and 10 percent level critical values in absolute form and fails to reject the null hypothesis, which means residual is not stationary. Overall, results show that both chosen variables and the residual are non-stationary. Hence, it is concluded that the variables are not cointegrated with each other. In addition, through cointegration test, we assumed that there was no long-run association among the variables, but there might be a short run association.

Since there is no cointegration among variables, the unrestricted VAR model is employed. In order to make the data stationary, the first difference of the variables are taken and tested again by the ADF test. Based on the t-statistics values given, the values are greater than the critical values in absolute form, which means the null hypothesis is rejected. The result of ADF test of differenced variables is given in Table 4.

Table 4 ADF test result with first difference.

Variables	t-statistics	p-value	1%	5%	10%
D(GDP)	−9.679748	0.0000	−3.521579	−2.901217	−2.587981
D(M2)	−6.935547	0.0000	−3.521579	−2.901217	−2.587981
D(GREV)	−10.64032	0.0001	−3.521579	−2.901217	−2.587981
D(GEXP)	−14.29786	0.0001	−3.521579	−2.901217	−2.587981
D(EXP)	−10.73145	0.0001	−3.521579	−2.901217	−2.587981
D(GDEB)	−7.035967	0.0000	−3.521579	−2.901217	−2.587981
D(COPP)	−6.903266	0.0000	−3.521579	−2.901217	−2.587981

Source: Author's estimation.

Akaike Information Criteria and Likelihood Ratio are mostly used for the lag selection. In the result, selected lag order according to AIC, HQ, LR, and FPE is Lag 1. According to residual autocorrelation LM test, and normality test results, choosing lag order one violates these conditions and lag-one is not enough for the analysis. For this reason, lag order two is selected as an optimal lag length.

Before running the estimation, we considered five out of seven variables as endogenous variables and remained two variables as exogenous variables (see Table 5).

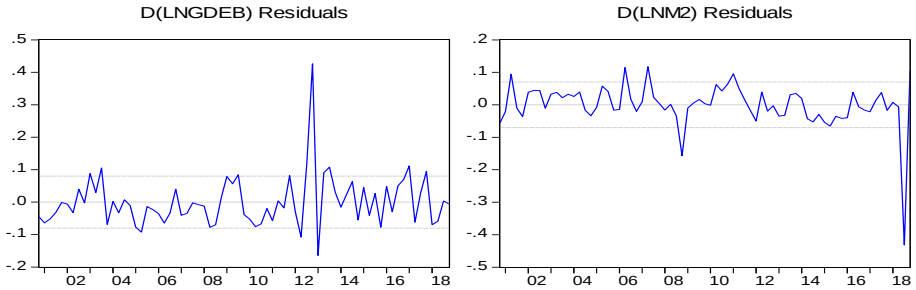
Table 5 Variables of VAR model.

Endogenous variables	Exogenous variables	Lag order
- D(GDP) - D(GREV) - D(GEXP) - D(EXP) - D(GOPP)	- D(M2) - D(GDEB)	2

Source: Author's estimation.

In terms of BLUE (Best Linear Unbiased Estimation) of coefficients of the VAR model, residuals have to be White Noise process and normally distributed. However, residuals of money supply and government debt resulting from VAR are not normally distributed based on Normality test of residuals. This result affects the joint Normality result, as well. Moreover, because of either unexpected drop or unpredicted rise in the data, these two variables may include outliers in the residuals (see Figure 1). Including outliers causes residuals to violate Normality test and reject the null hypothesis. For these reasons, these two variables are omitted from the model and added as exogenous variables.

Figure 1 Residual plot of GDEB and M2.



Source: Author's estimation.

Furthermore, based on AR root test result, these two variables influence the stability condition of the system. Based on the Granger causality test, these two variables neither have univariate nor bivariate significant causality relationship with all other variables. For this reason, variables are added to the model as exogenous variables in order to observe if it affects the economy, even though it violates prior tests. It is also important for us to learn how government external debt and money supply exhibit an impact on certain macroeconomic variables in the model.

Regarding the result of the estimation of VAR(5) model, we mostly focus on the relation of the variables whether it is positive or not, rather than focusing on interpreting the coefficients (see Equation 2).

Equation 2 VAR Model - Substituted Coefficients.

$$\begin{bmatrix} D(LNGDP) \\ D(LNGREV) \\ D(LNGEXP) \\ D(LNEXP) \\ D(LNCOPP) \end{bmatrix} = \begin{bmatrix} 0.033 \\ 0.047 \\ 0.051 \\ -0.0005 \\ -0.025 \end{bmatrix} + \begin{bmatrix} -0.256 & -0.023 \\ -0.314 & 0.392 \\ -0.099 & 0.430 \\ -0.085 & -0.109 \\ -0.634 & 0.240 \end{bmatrix} * \begin{bmatrix} D(LNGDP(-1)) \\ D(LNGDP(-2)) \end{bmatrix} +$$

$$\begin{bmatrix} -0.064 & -0.047 \\ -0.410 & -0.319 \\ 0.156 & -0.120 \\ 0.501 & 0.113 \\ 0.195 & -0.096 \end{bmatrix} * \begin{bmatrix} D(LNGREV(-1)) \\ D(LNGREV(-2)) \end{bmatrix} + \begin{bmatrix} 0.089 & 0.036 \\ -0.058 & 0.123 \\ -0.494 & -0.016 \\ 0.052 & 0.011 \\ -0.004 & -0.025 \end{bmatrix} * \begin{bmatrix} D(LNGEXP(-1)) \\ D(LNGEXP(-2)) \end{bmatrix} +$$

$$\begin{bmatrix} -0.031 & 0.062 \\ -0.036 & -0.016 \\ -0.114 & -0.026 \\ -0.128 & 0.021 \\ 0.214 & 0.058 \end{bmatrix} * \begin{bmatrix} D(LNEXP(-1)) \\ D(LNEXP(-2)) \end{bmatrix} + \begin{bmatrix} 0.182 & 0.056 \\ 0.441 & 0.099 \\ 0.138 & -0.049 \\ 0.085 & -0.033 \\ 0.194 & -0.201 \end{bmatrix} * \begin{bmatrix} D(LNCOPP(-1)) \\ D(LNCOPP(-2)) \end{bmatrix} +$$

$$+ \begin{bmatrix} 0.198 \\ 0.279 \\ -0.009 \\ 0.232 \\ 0.713 \end{bmatrix} * \begin{bmatrix} D(LNM2) \end{bmatrix} + \begin{bmatrix} -0.027 \\ -0.242 \\ -0.342 \\ 0.263 \\ 0.278 \end{bmatrix} * \begin{bmatrix} D(LNGDEB) \end{bmatrix} \quad (3)$$

In Table 6, only coefficients with significant t-statistics are given. According to the result of VAR estimation, it is said that today's value of GDP significantly and positively depends on the previous period value of copper price and the value of money supply. Future value of government revenue depends negatively on the previous first and second lag order value of itself and positively on the previous first lag value of the copper price. This means that if there is a shock given to copper price, the impact of this shock will influence to government revenue in the next quarter. The impact is positive.

Table 6 Final VAR results

Variables	Coefficient	Standard errors	t-statistics
	Dependent Variable: GDP		
D(LNCOPP(-1))	0.182478	(0.05404)	[3.37675]
C	0.032529	(0.01165)	[2.79170]
D(LNM2)	0.198313	(0.08829)	[2.24623]
	Dependent Variable: GREV		
D(LNGREV_SA(-1))	−0.410497	(0.14560)	[−2.81943]
D(LNGREV_SA(-2))	−0.318773	(0.14755)	[−2.16045]
D(LNCOPP(-1))	0.440601	(0.10571)	[4.16800]
C	0.046928	(0.02279)	[2.05881]
	Dependent Variable: GEXP		
C	0.050897	(0.02502)	[2.03401]
D(LNGDEB)	−0.342356	(0.17835)	[−1.91961]
	Dependent Variable: EXP		
D(LNGREV_SA(-1))	0.500868	(0.22870)	[2.19004]
	Dependent Variable: COPP		
D(LNGDP_SA(-1))	−0.633787	(0.37145)	[−1.70625]
D(LNEXP_SA(-1))	0.213536	(0.10824)	[1.97287]
D(LNM2)	0.713432	(0.20669)	[3.45176]

Source: Calculation of Eviews.

As for government expenditure, government external debt possibly negatively affects government expenditure. Previous first lag value of government revenue has a positive impact on the future value of export of Mongolia. This can be understood as increasing government revenue resulting in increasing government spending through hiring more people on the export sector or giving subsidies to large companies to stimulate the economy and this may lead to increase in export. Lastly, the most influential variable to

impact the next period value of the copper price is money supply according to the estimated result. It should also be noted that copper price is determined by many different factors. Therefore, Mongolian macroeconomic variables only play a small part. As for export and GDP, they show low significance t-statistics.

Four key tests are performed in the residual diagnostics which are autocorrelation LM test, Normality test, Heteroscedasticity White test, and VAR system stability test. Based on the significance level of the Autocorrelation LM test result, the null hypothesis fails to reject at lag order 2. Thus, there is no residual autocorrelation, which means that it is not necessary to omit variables and lag order two is enough for the analysis.

The statistics can be biased against the null hypothesis because of non-normal residuals (Sims, 1980). The chosen Normality method is the Cholesky of covariance (Lütkepohl, 2005). From the result of the normality test, the probabilities of all measurements indicate that it fails to reject the null hypothesis. From the Jarque-Bera joint test result, it is possible to say that the system of residuals is normally distributed. Residuals are also tested according to White Heteroscedasticiy with no cross term. According to the test result, we can conclude that residuals are homoskedastic. Based on the result of the AR root table, it is certain that no root lies outside the unit circle and that VAR satisfies the Stability Condition. This result also shows that the system is stationary. By having passed these tests, we are able to get better models for the analysis.

One main goal of this research is to define if there is any relationship between the given variables. We used Granger causality test to define the causal relationship of variables. Interpretation of this test as follows: If it is said that A is Granger cause of B, this implies that past and present values of A contain some information which is helpful to predict future values of B (Pesaran, 2015). Table 7 given below only shows significant results from Granger causality test. Other non-significant values are not provided.

Table 7 Granger causality test results

Dependent variable: D(LNGDP_SA)			
Excluded	Chi-sq	Df	Prob.
D(LNCOPP)	12.99300	2	0.0015
All(GREV,GEXP,EXP,COPP)	20.61104	8	0.0083
Dependent variable: D(LNGREV_SA)			
Excluded	Chi-sq	Df	Prob.
D(LNCOPP)	18.87552	2	0.0001
All (GDP,GEXP,EXP,COPP)	26.16184	8	0.0010
Dependent variable: D(LNEXP_SA)			
Excluded	Chi-sq	Df	Prob.
D(LNGREV_SA)	4.796452	2	0.0909

Source: Author's estimation.

Based on the p-value of the test, it can be concluded that the null hypothesis is rejected, which means that there are some causal relationships among dependent and independent variables. More precisely, an independent variable causes the dependent variable, thus,

the independent variable can possibly predict the dependent variable. The detailed interpretations of these results are given in the following table (Table 8).

Table 8 Interpretation of Granger causality test results

Dependent variable: GDP
Copper price does Granger cause GDP.
All variables (Government revenue, Government expenditure, Export, Copper price) jointly do Granger cause GDP
Dependent variable: Government revenue
Copper price does Granger cause Government revenue.
All variables (GDP, Government expenditure, Export, Copper price) jointly do Granger cause Government revenue.
Dependent variable: Export
Government revenue does Granger cause Export. (at 10 percent significance level)

Source: Author's interpretation.

As for government expenditure, no independent variable gives significant value. None of the independent variables Granger cause government expenditure. As for copper price, copper price is handled globally in the market. Hence, Mongolian economy indicators are not necessarily a cause of global copper price dynamics.

According to the interpretation given in Table 8, both GDP of Mongolia and Government revenue are sensitive to global copper price. It is possible to predict both GDP and government revenue future values by using copper price and joint of all other variables. In other words, the economic growth of Mongolia can be affected by the change of global copper price. So does the change in government revenue. This implies that the third hypothesis of our research is true, which is that GDP is sensitive to copper price shock. As for exports, the only variable that changes its dynamics is government revenue. However, the causal relationship is significant at 10 percent significance level.

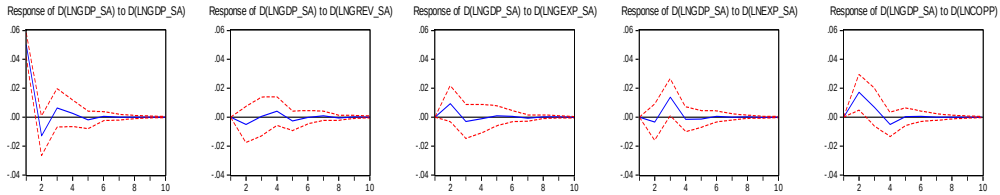
6.2. Impulse Response Function

One main goal of this paper is to study how the chosen variables respond to certain types of shocks. If there is a response of one variable to the impulse of another, it follows that the latter variable causes the former (Lütkepohl, 2005). In the IRFs, Cholesky decomposition method is used to evaluate the response of shocks. Cholesky ordering of IRFs is D(LNGDP_SA), D(LNCOPP), D(LNGREV_SA), D(LNEXP_SA), and D(LNGEXP_SA).

In IRF, the line between two asymptotic lines is IRF calculated by the model. Two asymptotic lines are 95 percent confidence intervals. In the graph, the horizontal axis starts from 1. IRF is usually considered as giving one standard deviation shock rather than one-unit shock to overcome measurement issues (Hill et al. 2008).

In Figure 2, it is most probable that shocks, which are given to the value of GDP of previous lags, affect the future value of GDP itself. From the second sub-figure, one standard deviation shock to government revenue (GREV) initially brings slightly negative impact on GDP. The volume of the response of GDP to government revenue shock is quite small and it fluctuates around its steady state. From the third sub-figure, one standard deviation shock to government expenditure (GEXP) brings the positive reaction to GDP in the first period and GDP goes back to its steady state in the second period and the response to shock disappears from the fifth period. From the fourth sub-figure, it can be seen that shock to export (EXP) presents a slightly negative reaction of GDP in the first period. However, GDP responds positively in the second period, and goes back to its steady state in the third period. Finally, in the last sub-figure, the response of GDP to shock to copper price is initially noticeably positive in the first period in relatively big volume compared to the other three. GDP declines in the next two periods.

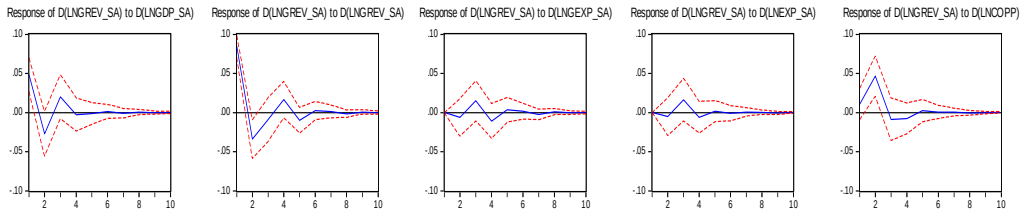
Figure 2 Response of GDP to other variable shocks.



Source: IRF estimation

The first sub-figure in Figure 3, government revenue initially responds negatively and decreases sharply in the first period. In the second period, government revenue goes up. The second sub-figure shows the response of government revenue to government revenue itself. The third sub-figure implies that government revenue reacts slightly negatively to government expenditure in the first period, then it positively reacts from the second period until the third period. The fourth sub-figure shows that government revenue responds positively to export shocks in the second period and is back to its steady state from the period five. In the final sub-figure, it is shown that government revenue responds positively to shocks to the copper price in the beginning. Copper price shock is effective in the first one or two periods and the response to shock disappears from the fourth period.

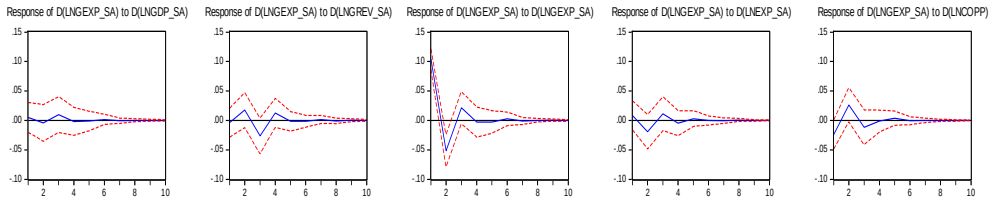
Figure 3 Response of Government Revenue to other variable shocks.



Source: IRF estimation

Government expenditure shows almost no response to the shock of GDP. GDP is not an effective tool to predict the government expenditure indicated in the first sub-figure (Figure 4). However, it reacts positively to shock to government revenue in the first period. In the second period, government expenditures fall lower than their steady state. The response of government expenditure is negative to shock to export in an initial period. However, it reacts positively in the next period, then gradually returns to its steady state. The response to shock to copper price is in the opposite direction as to export shock. In other words, the reaction is positive in the beginning and slightly wanes from the fourth period.

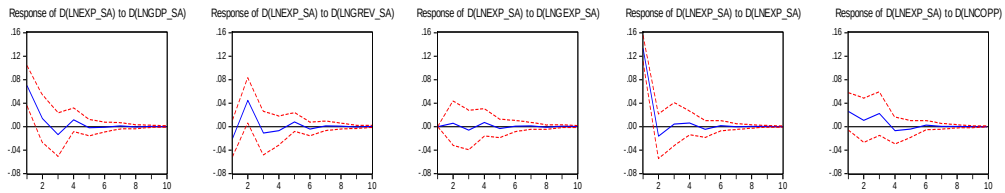
Figure 4 Response of Government Expenditure to other variable shocks.



Source: IRF estimation

Mongolian exports respond negatively to shock to GDP in the beginning. Export initially declines sharply in the first two periods and increases over its steady state in the third period (Figure 5).

Figure 5 Response of Export to other variable shocks.



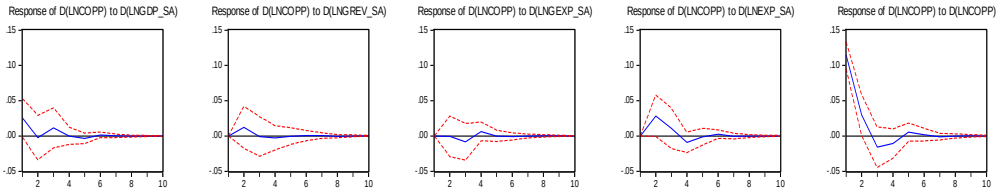
Source: IRF estimation

As for shock to government revenue, the export responds significantly positively in the first period. Then, it declines and fluctuates around its steady state. Government expenditure is not an effective tool to predict export. In case of giving one standard deviation of a shock to copper price, export responds rather stably above its steady state and gradually goes back to its steady state from the sixth period. A shock to GDP has a negative impact on export in the short run. In contrast, government revenue shock has a positive effect on export in the short run. Government expenditure has almost no effect on export either in the short run or in the long run. Shock to copper price has a gradual negative effect on export in the short run.

As we assume, the copper price usually does not respond significantly to shocks to Mongolian economic indicators. This can be observed from the following figure (Figure 6). However, shocks to export and GDP bring slight changes to the copper price.

Copper price responds negatively and fluctuates around its steady state to shocks to GDP. Copper price responds positively to shock to export in the first period and gradually declines in the second and third period. The impact of a shock to export disappears from the fifth period.

Figure 6 Response of Copper price to other variable shocks.



Source: IRF estimation

7. Conclusion

In the beginning, we had two research questions as follows:

- How does the economy respond to certain macroeconomic shocks?
- Is there any causal relationship between the key economic indicators considered in this paper?

We have obtained answers to both research questions through the analysis. We also had three hypotheses, only one of which is accepted. The accepted hypothesis is that the GDP of Mongolia is sensitive to global copper price shock.

Based on the result of the analysis, both previous value of copper price and the value of the money supply positively affect the next period value of GDP. Granger causality test provides that GDP is sensitive to copper price. IRFs provide evidence that in the short run, shocks to government expenditure, export, and the copper price have a simple positive impact on GDP.

Money supply is considered as an exogenous variable in the analysis. Its effect is positive on GDP. The next period government revenue is affected positively by the previous period value of the copper price. The Granger causality test also proves that government revenue of Mongolia is sensitive to global copper price. IRFs give information that in the short-run, shocks to copper price and export have noticeable and small positive impact on government revenue, respectively. In contrast, a shock to GDP has a negative impact on government revenue in the short-run.

Government external debt has a negative effect on government expenditure. Shocks to government revenue and the copper price have a positive impact on government expenditure in the short run and shock to export has minimal negative effect.

Previous first lag value of government revenue has a positive impact on the future value of export. This is given in the analysis that the only variable that results in export dynamics is government revenue. However, the causal relationship is significant at 10 percent significance level. IRFs indicate that shock to GDP has negative impact on export in the short run. In contrast, government revenue shock has positive effect on

export in the short run and shock to copper price has a gradual negative effect on export in short run. GDP. Government external debt also violates residual normality test, thus, we consider this variable as an exogenous variable.

Because the copper price is managed globally, the indicators impacting on this variable are few. GDP and export have weak significance in affecting the copper price and money supply is the only influential indicator according to VAR estimation. Global copper price can predict the dynamics of GDP and government revenue in the short-run according to the result of the Granger causality test. Shocks to GDP and export have negative impact on copper price in the short run.

Finally, there are four fundamental issues that should be discussed in further research. In order to obtain better model and better estimation results, the addition of data and variable is recommended. Also, the research could be extended by using different models in different countries and comparing the results. Most variables used in this paper are part of fiscal policy, therefore, our results could be useful in implementing effective fiscal policy.

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Chapter II
Changing business environment and new business models

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Corporate attitudes towards climate change and their implications for corporate governance

Péter Málits – Áron Drabancz – Nedim Márton El-Meouch

The position of science on climate change is quite consistent and grim, but humanity is currently not on the economic trajectory to avoid the most serious consequences. The aim of our research is to assess the financial implications of climate change based on the literature, as well as the attitudes of corporations towards the topic and the observable trends. Based on this review, we illustrate the relationships between climate risks (e.g. transitional and physical risks) and the corporate sector by building a model. According to the results of the modelling, the realization of climate change risks poses a real threat to the long-term operation of companies that are considered unsustainable by the markets.

Keywords: climate change, green transition, transitional and physical risks

1. Introduction

The activities of mankind cannot be separated from the natural environment, and its changes have an inevitable impact on social systems, including the economy. Climate change is therefore forcing economic actors to act.

There is no doubt that the world economy is facing a number of challenges nowadays, of which the most attention is currently being paid to the situation caused by the coronavirus. In the long run, however, based on the scientific consensus on the subject, the rising costs of climate change, and changing societal attitudes, tackling climate change could become the number one challenge of our time. So far, the adaptation steps and system-level changes have lagged behind the required level, as the related financial expenditures may result in a decrease in potential economic growth in the short run, which may also deter policy makers. However, due to increasing social pressures, this may change in the future, and it is even conceivable that fast and high-volume adaptation regulations could crack down on slow-responding companies. Thus, it is important to examine the challenges that corporate operations may face in relation to climate change. In our study, we approach the issue from a corporate perspective, within which we analyse the emerging transitional and physical risks. Using a general approach, the focus of our research is not on selected countries or regions, but on climate change issues affecting companies. We demonstrate our analysis using a model in which we incorporate different aspects of climate change, primarily transitional and physical risks, into a corporate project evaluation situation which is based on real-world data but is necessarily simplified.

Overall, the study pursues two goals: on the one hand, it systematizes the rapidly expanding literature, while it also presents the observable trends. On the other hand, in parallel, it highlights aspects of the realization of risks related to climate change that can influence corporate operations using a model. Based on all this, our research questions are the following:

- How can the direct financial risks of climate change be grouped and what characterizes them?
- Through what channels can observable trends appear in corporate operations?

In the next section of the study, we review the conceptual frameworks of climate change relevant to research. In the third section, we present the methodology used in the study, with special emphasis on the main features of the corporate model. Then, in the fourth part, we go through the financial risks and after that we summarize the main findings of the study.

2. The main features of climate change

In this section, we present the aspects of the phenomenon of climate change relevant to the study. To this end, we first consider it appropriate to have a precise definition of greenhouse gases. Natural science considers greenhouse gases to absorb some of the energy of the higher-wavelength radiation of the Sun reflected from the Earth's surface, thus warming the atmosphere as part of a fundamentally natural process (Civin 1998). Three-quarters of the greenhouse gases present in the Earth's atmosphere and specifically emitted by human activity are carbon dioxide (IPCC 2014), which is why the most attention is focused on this gas, all other greenhouse gases (such as methane) are also taken into account in terms of carbon dioxide. Two-thirds of carbon dioxide deriving from human activity comes from the combustion of fossil fuels, in descending order of quantity, coal, oil and natural gas. By sector, the three largest emitters are electricity and heat production, transport and transportation, and industrial production (IEA 2019).

It is important to mention the summary of the UN Intergovernmental Panel on Climate Change (IPCC) Comprehensive Report (IPCC 2018) published specifically for decision makers on the causes and consequences of climate change, as its findings provide conceptual frameworks for the whole study. The authors of the report have specifically sought to draw attention to the difference between making efforts to achieving a maximum increase in temperature of 1.5°C in 2015, instead of the 2°C maximum target adopted by the vast majority of the world's countries in the Paris Convention on Climate Change. Relevant findings of the IPCC report (IPCC 2018) for the study:

- human activity has now raised the average temperature of the Earth's surface by 0.8–1.2°C compared to pre-industrial times;
- global warming is likely to stop if humanity were to stop emitting greenhouse gases, especially carbon dioxide;
- warming in the range above 1.5°C would be expected to cause extreme weather events not seen in today's climate, leading to significant damage to the built infrastructure in parallel with rising sea levels;
- the effects of climate change may have a direct impact on, inter alia, human health, food supply and agricultural activity which is ubiquitous, but to a varying degree according to geographic location, leading to a measurable decline in the performance of the world economy as a whole;

- assuming that the current rate of greenhouse gas emissions is maintained, a very limited time interval separates humanity from reaching the level of emission that will cause a warming of 1.5°C.

Although climate change is indeed a complex process, its solution is, at least in theory, less complicated: in order to keep warming within the limits agreed in the Paris Convention on Climate Change, greenhouse gas emissions must be reduced in line with the IPCC's (2018) proposals. The ultimate manifestation of low carbon intensity is (net) carbon neutrality, meaning that a given economy emits less carbon dioxide than it can neutralize through natural methods or artificially produced technologies. McKinsey (2009) identifies 3 possible ways in which emission levels can be reduced. The most significant results can be achieved by increasing energy efficiency (for example by improving the fuel efficiency of transport vehicles or with better thermal insulation of buildings), followed by increasing the share of renewable (such as solar, wind, and hydroelectric power plants) and alternative energy sources (such as nuclear energy) in energy producing, and the third way is to achieve better management of agricultural land, in particular through greater protection of forests capable of binding carbon dioxide.

As Stern (2006) pointed out, climate change is an external phenomenon from a global economic point of view, in which the victims themselves are not always directly identifiable, as most of the negative effects will only be borne by future generations. Complemented by a significant uncertainty factor, these characteristics make climate change an extremely complex economic challenge. The effects of this adaptation on economic operators are presented in a way already mentioned, through the decision-making situation of a (oil) company.

3. Modeling methodology

The findings and trends of the literature in the following section will be incorporated into the model, adapted to the content of each sub-section in relation to the actual topic. This is why we consider it appropriate to review the methodology used for modelling at this point in the study.

3.1. The purpose of modelling and theoretical approach

The aim of the application of the model is to present a realistic example of the channels related to the studied phenomena that affect the operation of a company. Climate change considerations are rarely integrated into company decision-making mechanisms in current practice. However, it may be appropriate to present each scenario with its associated (estimated) probability of occurrence in relation to long-term investment decisions, as these may have an impact on the profitability of a given project and the profitability of the company. The constructed model, which necessarily simplifies reality, presents a methodology that can be potentially applied in real decision-making, when adapted to the characteristics of the given company.

In our example, a profit-maximizing company performing only one type of activity (oil refining) is facing a decision on a project. In the framework of the project the company envisages the commissioning of a high-carbon intensity *oil refinery unit*

related to the traditional oil industry, which is expected to operate over a 10-year period and will be linearly depreciated over the period without residual value. The net present value (NPV) calculated by discounting the cash flows resulting from the project is used as a decision criterion.

It is important to mention that the model presented in the study differs from real corporate practice in several respects. On the one hand, the net present value calculation is not used as the sole decision criterion, positive NPV can only be referred to as a necessary but not sufficient condition. Another significant simplification in the methodology is that because company management gives a forecast for the future in investment decisions, it is not able to calculate changes that do not exist at the time of the decision. In the following, therefore, our goal is not strictly to model the decision, but to identify events that could potentially influence it. Hence the question asked is not the general "is the investment worthwhile for the company" but "how would the company decide on the investment if it knew these changes were happening"? In addition, we use the following assumptions:

1. The company is not environmentally sustainable and has a poor rating. Its capital structure is constant and does not change during the period under review. This means that there is no financing-related economic event, the value of financing cash flow is zero. In order to simplify the calculation, we did not account for changes in net working capital (inventories, current assets, etc.). The rationality of the company management can be assumed, which decides on its investments only on the basis of the NPV. It is also an important assumption that in the model environment, a universal tax rate that applies equally to all is applied. The financial expense of the company consists exclusively of the difference between the interest paid and received, no other factors are taken into account.

2. In connection with the project, it can be said that the data were based on industry foundations, but cannot correspond to reality. In this way, the 10-year duration of the project is also a simplification in order to maintain the transparency of the project. This, in turn, leads in each scenario to the effects occurring over a period of time that cannot be considered realistic, but the goal is not primarily this, but to map the channels of the phenomena that affect the company's operations. The new production unit to be commissioned is paid in full in year zero, but does not generate income or incur costs that year.

3. In connection with each effect, their occurrence is assumed ceteris paribus so that the individual channels can be well separated. However, it is important to emphasize that it may be logical to assume their co-occurrence, in which case the impact on the decision is even stronger, and a smaller shock can cause more significant changes. In the initial model, revenues and expenses are constant over time. This simplification serves to generalize the model, as oil refining activity is highly exposed to changes in oil prices. For the sake of simplification, changes in each scenario immediately affect the decision, there is no way to compensate, such as raising the price of the product and thus increasing revenue, given the price sensitivity of demand.

3.2. Calculation procedure and initial parameters

The net present value (NPV) on which the decision is based is derived from the following equation:

$$NPV = \sum_{t=0}^{10} FCFF_t \times \left(\frac{1}{1+WACC_{project}}\right)^t \quad (1)$$

in which $FCFF_t$ is the expected (free) cash flow generated by the project and $WACC_{project}$ is the weighted average cost of capital of the project.

To determine the expected (free) cash flow (FCFF) generated by the project, it is necessary to calculate its after-tax profit (NOPLAT):

$$NOPLAT_t = EBIT - Tax\ burden - Financial\ expense = [Revenue_t - (Raw\ material\ cost_t + Operating\ cost_t) - \delta_t] - [EBIT * T] - [Interest\ expense - Interest\ income] \quad (2)$$

where δ_t is the annual depreciation rate, T is the (universal) tax rate.

Due to the indirect cash flow calculation approach, $NOPLAT_t + \delta_t = CFO$, where CFO is the value of operating cash flow if, according to the preliminary assumption, net working capital does not change. The sum of operating cash flow (CFO) and investment cash flow (CFI) in the model is equal to corporate free cash flow (FCFF) because we assume that there is no financing cash flow in the model. Free corporate cash flow is thus the result of the $FCFF = CFO + CFI$ relationship. The weighted average cost of capital for the project can be calculated based on the Modigliani–Miller (1958) methodology,

$$WACC_{project} = WACC_{company} + \alpha = \left[\frac{E}{V} * r_e + \frac{D}{V} * r_d * (1 - T)\right] + \alpha \quad (3)$$

where

- E is the market value of the company's equity stock;
- D is the market value of the company's liabilities;
- r_e is the company's return on equity under the CAPM (Sharpe 1964). $r_e = r_f + \beta \times (r_m - r_f)$, where r_f is the risk-free yield: the yield on the 10-year HUF government bond on 24 March 2021 (Trading Economics 2021), β is the beta corresponding to MOL Group's risk compared to S&P500 (Erste Market 2021), r_m is the market return, the expected average return of S&P500 between 2021-2030 (Scheid 2020);
- r_d is the return on the company's external liabilities (loans) (quotient of total interest expenses and total loans);
- T is the tax rate (the ratio of tax expense to pre-tax profit);
- α is the project-specific compensation term. The viability of this value is given by the goal of approximating the corporate WACC value calculated from the data in the report of MOL, which serves as a sample company, to the value typical of the oil refining projects mentioned in the report. It follows that the project under review is considered to be riskier than the operation of the company as a whole.

The company's financial data is therefore based on the 2019 financial statements of the MOL Group (MOL Group 2019). The initial values of each parameter recorded in the model can be read in Table 1.

Table 1 Parameters of the model company

	(HUF million)
E	2,451,369
D	2,680,918
V	5,132,287
E/V	47.76%
D/V	52.24%
Earnings before tax	275,699
Tax expense	47,318
T	17.16%
Total loans	909,039
Total interest expense	19,946
r_d	2.19%
r_f	2.71%
r_m	6%
B	1.23
r_e	6.76%
A	3%

Source: Own construction

The company therefore decides on an oil refinery as part of the investment decision. Its zero-year (one-time, immediate payment) investment cost (CAPEX) is 5.5 billion dollars. We assumed all this based on Tuttle (2019), who mentioned in his writing that the cost of building a plant capable of refining 100,000 barrels of oil per day is 6.9-8.6 billion dollars in Canada and 2.9-3.6 billion dollars in China. The capacity of the plant is accordingly 100 thousand barrels/day. We assume this is Brent oil, of which Fitch Ratings (2021) estimates a unit price of 53 dollars per barrel in the long run. Assuming 360 days of operation per year, this represents a total annual raw material cost of 1,908 million dollars. According to Robinson (2006), the cost distribution typical of oil refineries is that 85 percent is crude oil and 15 percent is other operating costs. Using this, the annual operating cost is 336.7 million dollars. Based on all this, the total annual cost is 1908 + 336.7 = 2,244.7 million dollars. Based on Avdeev&Co. (2021), we assume an average gross margin of 30 percent. Using the total cost calculated above, the annual revenue is 3,128.5 million dollars.

Based on all this, the initial parameters of the model (values in millions of dollars) can be read in Table 2. In the initial model, NPV = 445 million dollars, so rational corporate management would use its current knowledge to decide to implement the project. In this study, we use a sensitivity analysis approach for each scenario. This means that we show how much impact is required in a given factor to result in just zero net present value for the given company and project characteristics.

Table 2 Initial parameters of the model

	Year										
Name	0	1	2	3	4	5	6	7	8	9	10
(1) Revenue	0	3206.7	3206.7	3206.7	3206.7	3206.7	3206.7	3206.7	3206.7	3206.7	3206.7
(2) Raw material cost	0	1908	1908	1908	1908	1908	1908	1908	1908	1908	1908
(3) Operating cost	0	336.7	336.7	336.7	336.7	336.7	336.7	336.7	336.7	336.7	336.7
(4) EBITDA (1)-[(2)+(3)]	**0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**
(5) Depreciation	0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0
(6) EBIT (4)-(5)	**0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**
(7) Financial result	0	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9
(8) Tax burden	0	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7
(9) NOPLAT (6)-(7)-(8)	**0**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**
(5) Depreciation	0	550	550	550	550	550	550	550	550	550	550
(10) Operating CF (9)+(5)	**0**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**
(11) TE procurement (CAPEX)	5500	0	0	0	0	0	0	0	0	0	0
(12) Investment CF [-(11)]	**–5500**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
(13) FCFF (9)+(12)	**–5500**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**
(14) Discount rate	1	0.9330	0.8706	0.8123	0.7579	0.7071	0.6598	0.6156	0.5744	0.5359	0.5000
(15) PV (13)*(14)	–5500	796.24	742.92	693.18	646.76	603.45	563.04	525.34	490.16	457.34	426.72
NPV [(15) sum]	**445**										

Source: Own construction

4. Financial risks

In the next section, we examine the direct financial risks of climate change. The findings reviewed at the beginning of each sub-section are incorporated into the corporate decision model presented in the previous section in the second half of the sub-sections. There is basically a consensus in the literature on the types of risks. To identify these, we use as a main starting point the recommendations of the TCFD[1] made to economic operators under the auspices of the Financial Stability Board (FSB), which is closely linked to the G20 (TCFD 2017). The body was set up to develop a methodology for publishing climate-relevant corporate information. In the report, the authors distinguish between transitional and physical risk and assign economic and financial consequences to these.

4.1. Transitional risks

TCFD (2017) classified transitional[2] risks as the first risk type, of which four subtypes can be distinguished.

One of these is the group of legal-political risks, such as a sudden increase in the cost of greenhouse gas emissions (for example, through the introduction of a tax), which from a financial point of view could lead to an increase in costs and an obligation to pay any emission penalties. Also included are costs incurred as a result of new regulations applying to a particular group of raw materials (in this case, coal or oil, for example), which thus becomes a stranded asset. Consistent with this, McGlade and Ekins (2015) concluded that, to achieve the maximum warming level of 2°C from the Paris Climate Convention, a third of the currently known oil reserves, half of all natural gas reserves, and 90% of the world's coal reserves would become such devices because they cannot be used.

Factors of technological origin were classified in the second subtype of transitional risks. Manifestations of this include the need to replace companies' current products and services with lower-emission alternatives in order to stay on the market, and the risk that the introduction of new technologies will lead to failure. From a financial point of view, the increased capital expenditures on research and development and the increased capital requirements following the implementation of new solutions are what can be a problem here.

The third subtype is the group of transitional risks of market origin. These include changes in consumer behaviour and increases in commodity prices linked to climate change, the negative financial impact of which is due to, among other things, declining demand for the products of a company operating in a carbon-intensive industry, rising raw material costs or a profound transformation of the company's cost structure.

The final transitional risk is the perception risk that the reputation of a company operating in "more polluting" industries will deteriorate in the eyes of consumers and

[1] Task Force on Climate-Related Financial Disclosures

[2] By transition the process itself is meant, during which an economic model is established in which the pursuit of economic activities involves the emission of less carbon dioxide (and its equivalent gases).

other stakeholders (including investors). This may be detrimental to economic operators in terms of declining demand and declining available capital.

Pointner et al. (2019) approach the question somewhat differently. In their research, 6 traditional banking risks (credit, market, liquidity, operational, reputational, systemic) were taken into account and the risks arising from the transition were assigned to them. For the groups formed in this way, the effects of risks on the financial system were named. In terms of types of risks, there is significant overlap with the recommendations of the TCFD (2017), the uncertainties concerning future regulations and uncertainties regarding the level of real interest rates resulting from the impact of a possible carbon tax on inflation are introduced as new elements. The most significant difference in their research is that the effects, introduced by the TCFD mainly from a corporate perspective, are passed on to the banking system. In several cases, it appears that the aforementioned challenges for companies result in higher loan loss rates, thus jeopardizing banks' profits, in response to which they may set higher levels of risk premiums. Also, relevant findings of the authors of the study is that the Paris Climate Convention sets clear limits on greenhouse gas emissions, so a transition is inevitable.

The aspect often appears as well (e.g. Bank of England 2018; Rudebusch 2019) that a sudden switch to renewable energy makes it inevitable for the market to reprice the shares of companies operating in carbon-intensive industries, which could significantly reduce the market value of these securities and thus the company. Considering Battiston et al.'s (2017) finding that 45 to 47 percent of all financial intermediaries' assets are exposed in industries that may be directly affected by environmental regulations, this can be assessed as a significant risk that could ultimately undermine the stability of the financial system.

Modelling the impact of the realization of transitional risks on corporate project evaluation – tax shock

In the corporate decision situation depicted in the constructed model, we analyse the effect of a sudden tax on the transitional risks. Our assumption is that in a country relevant to the company, a government will come to power that seeks to achieve emission reductions by drastically taxing companies operating in carbon-intensive industries. The issue of carbon-dioxide tax has been raised at several points in the study, and real examples of this can be seen, so the assumption has a basis in reality. Table 3 illustrates the mechanism of action of this scenario.

In this scenario, we approach the question with a sensitivity test to examine what is the tax rate that leads to zero net present value if this tax is levied in the first year and remains unchanged thereafter, and if it is levied from year 6 and stabilizes thereafter. This seemingly arbitrary choice of years is justified by the fact that the primary aim is to demonstrate the mechanism of the effects and to illustrate the time differences observed in the occurrence of the effects, the examination of which these two dates thus allows. One of our basic assumptions was that all activities have the same T tax rate, so in the calculations this is reflected in the discount rate as part of the weighted average cost of capital and as a factor influencing corporate earnings. The results are summarized in Table 4.

Table 3 The mechanism of action of the realization of transitional risks

Event	Causes	Impact on corporate decision
Realization of transitional risks: tax shock	A change in public thinking due to extreme weather events or other reasons that puts pressure on policy makers to tax the most polluting companies	1) Increases the present value of cash flows by decreasing the discount rate 2) Reduces the present value of cash flows by reducing after-tax profit

Source: Own construction

Table 4 The sensitivity of the model firm's project appraisal to tax shock

Impact of the tax increase	Tax rate	Increase (percentage point)	Increase (%)
Base case	17.16%	–	–
Tax increase from year 1	34.4%	17.25%-points	100.50%
Tax increase from year 6	60.72%	43.56%-points	253.81%

Source: Own construction

As can be seen, in the first case, the tax rate resulting in the NPV = 0 level is 34.4%, which represents an increase of 17.25 percentage points, or 100.5 percent, compared to the initial value of 17.16 percent. In the second case (when the tax shock occurs in the sixth year), a tax rate of 60.72 percent of zero net present value can be achieved with an increase of 43.6 percentage points to 253.81 percent from the initial level. Although, among other things, the European Green Deal mentions the tightening of the carbon tax policy in the EU as an aim (European Commission, 2019), such an increase is not realistic in the current political climate in Europe in the period under review. The scenario is conceivable if extreme (e.g. weather) phenomena occur that fundamentally change the public mood, and much larger masses than at present demand more strong action from policy makers against climate change.

4.2. Physical risks

Another type of risk with financial consequences is the physical realization of hazards. We need to highlight, that this kind of risk poses a challenge for all companies, not just the ones operating in energy-intensive sectors, however, we continue our modelling with the same model company. One subcategory of this type includes acute risks, which can be seen in the increasing incidence of extreme weather events, the other subcategory includes chronic risks, such as changes in longer-term weather trends such as rainfall distribution, average temperature and sea level rise. There is basically a consensus in the literature that these two types of physical risk can be distinguished. However, it is typical to further expand and broaden them, and to take other aspects into account. In

their study cited above, Pointner et al. (2019) also used physical risk sources to link them to traditional banking risks and examine their effects on the financial sector. According to their study, extraordinary weather events infiltrate the banking sector through the losses of their affected customers and the loss of their ability to repay their loans, but in the case of a more severely affected country, even increased capital withdrawals due to increased country risk can be considered as a likely consequence, which can increase exchange rate volatility. That increasing country risks is a truly relevant issue is well illustrated by Klusak et al. (2021) who found that assuming that the current rate of emissions is maintained, the credit ratings of 63 countries could deteriorate by 2030 solely because of climate change risks, which could increase interest rates on sovereign government bonds, placing a significant additional burden on public budgets around the world.

The negative impact of physical risk on economic performance realized in more frequent extreme weather events is often mentioned in the literature (Sterner 2015, TCFD 2017, DNB 2017, Olovsson, 2018, Pointner et al. 2019). This is done by the fact that these events have an impact on factors of production, leading to a reduction in economic output. Using a different approach, the same result is reached by Rudebusch (2019). He noted that the adverse effects of weather extremes on corporate creditworthiness would lead to increasing uncertainty in the entire financial sector. This uncertainty will ultimately lead to higher lending rates and higher consumer savings rates, and through this will lead to lower economic performance.

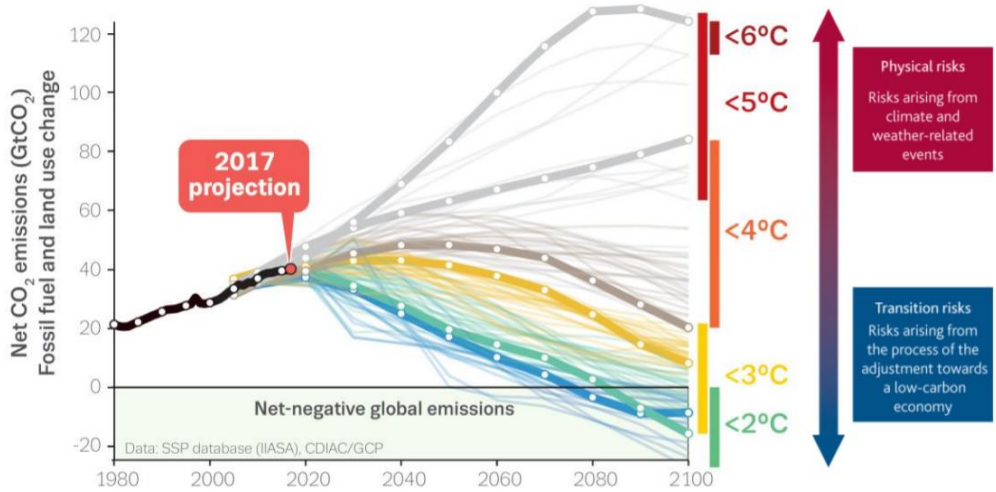
Related to the former is the content of The Economist Intelligence Unit's (2015) study on quantification (*Value at Risk*) and forecasting of financial risks. In this, the authors tried to predict what the cost might be if there was no reduction in greenhouse gas emissions. According to their findings, in an extreme case, assuming a warming of 6°C, nearly a third of the world's total allocable assets will lose their value. According to the research, a small proportion of financial institutions have taken steps to estimate and manage the risks posed by climate change.

All in all, higher lending rates are a plausible consequence which could cause financial issues for companies, the most for which are operating in energy-intensive sectors. Aside from that, individual and institutional investors could also change their behaviour and climate-conscious investment thinking become more prominent, one good example being the ESG rating system that has appeared in recent years. The consequences of the realisation of transitional and physical risks concerning the credit and capital market are not examined in detail in this study.

The link between the increasing frequency of extreme weather events and climate change has already been pointed out in several studies (see, for example, Coumou and Rahmstorf 2012). The financial implications of extreme weather events are often the subject of research in the scientific sphere (e.g., Hsiang and Jina 2014, Schüwer et al. 2017). One of the findings of Klomp's (2014) research on the effects of natural disasters on financial stability, covering 160 countries and spanning 13 years, is that the realized effects depend significantly on the level of economic development of the affected country and the rigor of its financial regulation and supervision.

The opposite direction of the physical risk reviewed in this subsection and the transitional risk presented in section 4.1 was pointed out by a study by the Bank of England (2018) (Figure 1).

Figure 1 The opposite direction of the increase in physical and transitional risks.



Source: Bank of England (2018, 9)

Practically, this means that two scenarios can be imagined going forward in time. Assuming that the carbon-dioxide emissions continue at the current rate, the likelihood of physical risks occurring will increase due to the intensifying warming. If, on the other hand, emissions are successfully reduced to a lower level, the occurrence of physical risks are less likely due to the lower level of warming, but this will lead to an increase in transitional risks over time, since lower emissions presuppose the introduction of lower carbon practices in the economy. Thus, the later the transition begins, the greater the risk posed by one or the other risk, which is why timely action is critical.

Modelling the impact of the realization of physical risks on corporate project evaluation

With regard to physical risks, we basically present the impact of the increasing number of extreme weather events on corporate operations with the help of the model: first incorporating the realization of chronic risks and then the acute risks. There are also specific limitations to this scenario: much depends on where the company is geographically active and what such exposure other actors in the value chain have.

For simplification, we take the study of Cruz and Krausmann (2013) as a basis. In this, the authors examined the extent to which oil and gas infrastructure is exposed to physical risks. Among the chronic physical risks, the possible consequences of warming and among the acute risks, the possible consequences of storms and flash floods were listed in relation to the different stages of the oil industry value chain (extraction, transportation, refining). They illustrated the effects of these events with real examples

and drew their conclusions from it. Based on these, warming appears in operating costs (e.g., heat reduces the capacity of machines, so more energy investment is required), and extreme events can cause huge one-time costs. They conclude that it is essential that industry players incorporate these risks into their operations and take adaptation steps.

We incorporate this into the model through an overview of two contingencies, the characteristics and effects of which are summarized in Table 5.

Table 5 The mechanism of action of the realization of physical risks

Event	Causes	Impact on corporate decision
Realization of chronic physical risks	As a result of warming, the efficiency of the company's means of production deteriorates	An increase in operating expenses that reduces profit and, through this, the present value of cash flows
Realization of acute physical risks	Extreme weather phenomenon that causes a significant deterioration of corporate infrastructure	Impact on CAPEX and through it on investment cash flow that reduces the present value of cash flows

Source: Own construction

In the first case, we model the increase in operating costs due to warming (chronic risk). Here, we examine the level of increase in operating costs that would result in a project being rejected if this cost increase occurred from the first year or only from the sixth year, assuming that the decision makers are aware of this at the time of the decision. The results are summarized in Table 6.

Table 6 The sensitivity of the model firm's project evaluation to the realization of chronic physical risks

Operating costs	Cost (USD million)	Increase (%)
Base case	336.71	–
Increase from year 1	413.85	22.91%
Increase from year 6	522.93	55.31%

Source: Own construction

Such an increase in operating costs is undoubtedly drastic. However, the example also illustrates that, depending on the cost structure, this factor may have a real impact on the project appraisal decision.

In the second case, we examine the effect of the realization of the acute physical risk, in the framework of which the plant suffers severe storm damage (flash flood). Cruz and Krausmann (2013) recall the flooding of the El Maleh River in Morocco in 2002 following a storm that destroyed seventy percent of the thermal power plant at the adjacent oil refinery complex. This is represented in the model as an impact affecting

CAPEX (and thus investment cash flow). Due to the nature of the net present value calculation, the later such an effect occurs during the period under review, the smaller the effect it has on the present value and thus on the decision. We assume that the extent of the destruction (expressed in percentages) the event causes will require the same amount of material expenditure for restoration. We examine the amount of damage in each year (expressed as a percentage of the investment amount in year zero) that, if it had been known at the time of planning, would have encouraged management to reject the project. The results of the calculation are summarized in Table 7.

Table 7 Sensitivity of the model firm's project evaluation to the realization of acute physical risks

Year	1	2	3	4	5	6	7	8	9	10
Cost* (%)	8.67	9.30	9.96	10.68	11.45	12.27	13.15	14.09	15.10	16.19

*The rate of loss of events resulting in zero net present value as a percentage of the initial investment amount
Source: Own construction

Table 7 shows that in the first year, the loss of only 8.67 per cent of the initial investment amount would have led to a net present value of zero, this value increased to 16.19 per cent over time. Although it is not justified to present such events as real decision criteria in the absence of information on the likelihood of their occurrence, depending on the geographical location of the entity and the characteristics of the industry, this perspective may appear in the design – for example, in the case of an agricultural enterprise, it is worth presenting this aspect even more strongly.

As the preliminary results of the European Central Bank's economy-wide climate risk modelling show, both physical and transitional risks pose a real threat to the functioning of the economy as a whole. The results also show that an unscheduled transition is also a threat to financial stability (De Guindos 2021).

4. Conclusion

In this study, we examined the financial and economic risks of climate change and their aspects affecting corporate operations through a review of the relevant literature and through the investment decision of an oil company based on this.

There is an extremely broad scientific consensus behind the fact of the threat of climate change. The two types of financial risks are transitional and physical risks, which are also potential threats to overall financial stability. The same factors can also affect the actors of the real economy through the interconnection of economic sectors. In a corporate decision model constructed with the necessary simplistic assumptions, the firm's sensitivity to the realization of transitional risks were presented through a tax shock, while its exposure to the emergence of physical risks were demonstrated through an increase in operating costs in the wake of warming, and for the acute physical risks, through the negative impact of a storm on production infrastructure.

It was also clearly observed in the models that the later an impact takes effect, the greater it must be to change the sign of the net present value of the cash flows generated by the project (provided that decision makers have prior information about it). However, this is a real possibility in each of the examined scenarios, as one of the most important lessons of the study is that the sooner the adaptation begins, the less drastic steps need to be taken to avoid the most adverse consequences. The results also point out that companies in industries with a traditionally high environmental impact will be more exposed to the risks of economic transition if they do not diversify their portfolios in time.

Developing tools similar to the model outlined in the study and adapting them to real corporate conditions can help integrate climate change considerations into decision-making, a practice that is not yet widespread, but can be an important tool for assessing and quantifying firms' climate-related operational risks.

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A review of the Balanced Scorecard method through comparing the relevant literature of selected European countries

Viktor Vágner

The importance of evaluating companies and measuring their performance is evidenced by a number of cases, for example, global phenomena going on currently. Not so long ago, in 2013, the European Parliament and the Council adopted the Directive 2013/34/EU, which is mandatory and provides comparable and clear financial statements of companies. Therefore, the study applies mainly the method of scientific literature synthesis and compares studies carried out in various Central and Eastern European countries. They are related to the use of the Balanced Scorecard performance measurement method applied in stock companies. In parallel, the perspectives of key stakeholders are also reviewed based on their published reporting practices. The comparison shows that the Balanced Scorecard method is really suitable for external users. Important information, measures and performance indicators can be reported and analysed using the company's annual reports.

Keywords: nonfinancial performance measurement, Balanced Scorecard, joint-stock companies, annual reports, stakeholders

1. Introduction

Changes and uncertainties have been increasing around us in recent years as well, not to mention the corporate sector, as companies are facing even more often these rapidly changing external and internal effects. Considering the change of regulation, it is essential particularly for the traders of securities to comply with the new expectations and regulations. Thus, they are more likely to remain competitive, as a company operating in a unified and international environment can report its results more effectively and is able to draw the potential investors' attention more easily to itself. At the same time, regulations impose a constant adjustment force and a heavy burden on stakeholders, especially as far as major changes are concerned.

It has long been a generally accepted opinion among managers that the performance of companies should be examined and presented from different points of view, taking account of the most important stakeholders who come into contact with them. Emphasizing the results achieved by companies towards stakeholders has become increasingly important. Thus, in addition to the disclosure of mandatory financial reports and annual accounts the presentation of non-financial information and measures has also become useful. Performance measurement systems (PMS) based on financial and non-financial measures of companies primarily provide confirmation of results to managers, owners and other internal stakeholders. However, they can also provide a function which is suitable for communicating relevant information to external stakeholders. One of these performance measurement methods is the Balanced Scorecard. With the help of the four perspectives making up the system, it is possible to achieve the goals tailored not only to the internal but also to the external stakeholders' expectations and needs.

2. The Balanced Scorecard as a performance measurement tool

To support organizational performance, a number of strategic management tools and techniques (SMTT) can be proposed (cost-benefit analysis, activity-based costing, Balanced Scorecard, customer profitability analysis, etc.). These contribute to the improvement and maintenance of customer satisfaction and to increasing market share and profit by understanding the company's position and comparing it with its competitors (Afonina 2015). A large number of studies have been carried out using mostly questionnaire research on the use of strategy management tools and non-financial measurement methods (Todorovic et al. in Serbia in 2015, Rajnoha–Lesníková in 2016 in Slovakia, Afonina in 2015 in the Czech Republic).

The Balanced Scorecard by Kaplan and Norton has emerged as one of the most popular strategic performance measurement tools in recent years. In addition to profit-oriented companies it was successfully adapted by public organizations, non-profit organizations, as well as state organizations and local governments. Moreover, proposals have been made to reorganize the operational structure of the institutions of higher education by introducing the business model (Sartorius et al. 2010, Greiling 2010, Kozma–Kazainé Ónodi 2014, Gácsi et al. 2015).

The Balanced Scorecard system was originally designed by Kaplan and Norton (1992) to measure performance. In addition to measuring the performance of the traditional financial measures at the crossroads of our age, the indicator includes measures on operational, non-financial measures of customer satisfaction, internal processes and the innovation and improvement activities of the organisation. Financial information in itself is no longer sufficient to make decisions, we can get a much more accurate and reliable view of the overall performance evaluation if we consider the results of non-financial aspects and measures too. This way the expectations of the involved stakeholders can also be met (Low–Siesfeld 1998). Companies focusing only on financial measures are no longer able to maintain their competitive advantage (Jovetić–Puric 2016). Although, a company's financial performance is a key issue, the problem is still rooted in the fact that a company's performance is manifested in different approaches from the perspective of each stakeholder, i.e. it can be debated whether value creation is achieved for all stakeholders (Jáčová–Brabec 2017).

Traditional financial performance measurement systems are not linked to operational strategies. Based on financial data, they focus on the past and on cost reduction. Besides, individual interests are realized. In contrast, strategic measurement systems work for operational strategies and can be characterized by customer orientation, that is, they focus on the future. Improving performance is of great importance. Strategic measurement systems are permeated by group incentives to ensure learning throughout the organization (McNair et al. 1990).

Based on an observation of 12 companies for a decade, Kaplan and Norton (1992) found that managers aim for a balanced presentation of financial and operational measures. To achieve this relying on multiple packages of measures is also not excluded. Viewing theoretically and considering previous research results, it has been proved that the use of different management tools and techniques helps companies in the following:

- responding to changes in the internal and external competitive environment,
- structuring strategy management activities,
- supporting the decision-making process,
- meeting customer needs,
- improving financial performance,
- rationalizing production costs and highlighting new opportunities.

Thus, the adoption and combination of different management tools and techniques may improve financial and non-financial measures (Afonina 2015, 22).

Based on the observation of the companies, Kaplan and Norton (1992) concluded that top managers were using measurement methods that also included the vision and priorities of the companies.

It was found that the performance indicators selected by the companies contained highly valuable information for the development of the future strategy. Besides, the companies integrate these performance indicators into a management system. Therefore, the Balanced Scorecard is much more than a performance measurement system (PMS). Apart from being suitable for evaluating financial and non-financial data, it can also be used as a management system in the field of strategic management.

The Balanced Scorecard is to be visualised in the centre of corporate governance systems, enabling short-term financial performance to be tracked. Moreover, the company's strategy can be evaluated viewing the recent performance. The authors emphasize that the concept of the Balanced Scorecard must be proclaimed to the entire company so that everyone, the owners and the employees alike, understand the long-term strategic goals. Furthermore, the results of these measures have to be communicated to the potential investors too (Kaplan–Norton 1996).

Theoretically, the interrelationship of the four separate perspectives of the Balanced Scorecard – financial performance, customers, internal business, innovation and learning – allows the performance of the company to be evaluated not only by the owners and shareholders but also by the stakeholders. This is supported by Vinten's (2001) "stakeholder theory", according to which companies should be run considering the interests of all stakeholders. As Sternberg has it, an organization's stakeholder can be any group or individual who can influence the organization (Vinten 2001).

The strategically relevant stakeholders are shareholders, customers and employees, while the possible stakeholders are the potential shareholders, customers and employees. Moreover, the suppliers or the entire society may be further strategically important parties (Bieker 2005). Competitors related to the companies, even those with significant influence, should not be ignored.

The Balanced Scorecard was designed to take stakeholders' needs increasingly into consideration. This is reflected in the explicit focus on customers', employees' and shareholders' interests. This is, however, only possible if corporate strategic goals are met (Bieker–Waxenberger 2002).

3. The relationship between the Balanced Scorecard and the stakeholders

The Balanced Scorecard seeks answers to four key questions: how do we look at the owners? (financial perspective); what is the customers' opinion of us? (customer perspective); what do we need to excel in? (internal perspective); and are we able to improve further and create value (innovation and learning perspective)? (Kaplan–Norton 1992, 72). Each activity and measure in terms of perspectives should be evaluated on the basis of their impact on the companies' profitability (Bieker and Waxenberger 2002). Stakeholders' needs and requirements are integrated into these four perspectives (Bieker 2005).

In what follows, I discuss the relationship between the Balanced Scorecard and the key strategic stakeholders with a review of the relevant literature.

3.1. Customers

There are many companies that focus primarily on customers. According to Kaplan and Norton (1992), factors considered by customers as really important fall into four categories: time, quality, performance and service, and costs. In order to meet customer expectations indeed, it is worth developing the company's own performance indicators based on external measurements and data collected from customers. Excellent performance can still be achieved by using internal decisions and actions due to processes within the organization. To meet customer needs managers need to focus on critical internal operations.

The internal measures of the Balanced Scorecard should derive from business processes that have the greatest impact on customer satisfaction. In terms of innovation and learning, which promote the stability of the production of new products rather than the improvement of the production of current products, the introduction and acceptance of new products represent the greatest value creation for customers.

Traditional financial measures do not improve customer satisfaction, quality, cycle time, or employee motivation. Although the source of financial performance is the result of the operational actions, even the alleged relationship between better functional, operational performance and financial success can be described as rather weak and uncertain. Authors explain this with an example describing that it is not at all certain that a significant improvement in production capabilities will lead to greater profitability.

3.2. Employees

Within the frame of an internal business perspective, managers need to develop measures influencing employees' behaviour and attitudes to achieve goals related to time (cycle time), quality, productivity, and cost. With all these the importance of increasing customer satisfaction and that of continuously improving internal business processes can be emphasized.

The Balanced Scorecard also shows to the shareholders and customers what the organization aims for. To align the employees' individual performance with corporate strategy, Balanced Scorecard users need to engage in three activities: communication and education, setting goals, and linking rewards to performance measures. Proclaiming

the Balanced Scorecard fosters employees' commitment to long-term strategy and contributes to the realization of the company's vision (Kaplan–Norton 1996).

Due to globalization, the performance of a company increasingly depends on the knowledge and skills of human resources. It is the only factor of production that can quickly and actively respond to environmental change. Human resources (the ability, talent and knowledge of a company's employees) represent an immaterial category (in addition to informational and organizational capital) in terms of learning and innovation. They are essential for the implementation of any strategy (Kaplan–Norton 2004).

Employees' knowledge and skills are currently one of the most important factors in staying in business. Unlike financial and real assets, immaterial assets are difficult for competitors to imitate. They can help maintain a competitive advantage. If managers are able to estimate the value of immaterial assets correctly, they can measure the competitiveness of their company much more easily and accurately (Jáčová and Brabec 2018).

3.3. Shareholders

The financial perspective of the Balanced Scorecard is typically related to profitability, revenue growth, and shareholder value. For financial analyses, authors recommend shareholder value analysis (SVA), which provides a predictive value by discounting the estimated value of future cash flows to present value. As for innovation and learning, breaking into new markets can cause an increase in revenues. Thus, shareholder value is boosted (Kaplan–Norton 1992).

The authors encourage senior management to inform potential investors about the promising results due to the measures. To do this their annual reports should be expanded with strategic measures as well. Details about e.g., market share, customer satisfaction, employee competence, technology deployment can also be made known. Thus, in theory, the Balanced Scorecard can also be used for the communication and evaluation of the strategy outwards (Kaplan–Norton 1996).

The Balanced Scorecard creates a balance between the external actions for customers and shareholders and the business processes, innovation, learning, and the internal measures of the growth (Chavan 2009).

Based on Kaplan and Norton's work, Table 1 summarizes the aspects analysed by stakeholders using the Balanced Scorecard.

Table 1 Performance measurement applying the Balanced Scorecard method according to the criteria evaluated by each stakeholder

	Customer perspective	**Internal business process perspective**	**Learning and innovation perspective**	**Financial perspective**
Customers	Time, quality, performance and service, costs	–	–	–
Employees	–	To help the company achieve its goals and realize its vision	Continuous possibility for learning and improving, satisfaction	Linking rewards to performance
Shareholders, owners	–	–	–	Profitability, growth, shareholder value

Source: Own creation based on Kaplan and Norton (1992), (1996), and (2004)

4. Application of the Balanced Scorecard for joint-stock companies from the perspective of three countries

Plenty of studies examine the performance measurement function of the Balanced Scorecard. Otherwise, there are a number of differences in the way research is conducted and the number of samples analysed.

The following studies examine different countries with different sample sizes. What is common in all cases, however, is that the joint-stock companies were scrutinized. The practice of publishing performance indicators was studied mainly on the basis of the records and reports disclosed by the companies.

4.1. Austria

Mühlbacher and his associates (2016) examined what kind of information companies on the Austrian stock exchange disclose in their business reports regarding their strategic performance. To do this, the annual reports of 20 companies were examined, at two distant dates, in 2002 and 2012. Applying documentary and content analysis, the changes and trends in the disclosure of information of the listed companies were examined. All these were grouped into three categories considering three perspectives out of the four of the Balanced Scorecard – customer perspective, internal business perspective, innovation and learning perspective – excluding the financial one.

The aim of the study was to determine the extent to which non-financial performance indicators appear in the annual reports. It was assumed that the disclosure of non-financial measures should strengthen employees 'commitment to a long-term strategy.

The analysis of the annual reports found that non-financial measures showed a great increase from 2002 to 2012. It is solely due to the increased disclosure activity of innovation and learning perspectives. The number of disclosed non-financial measures showed a 44% increase by 2012 (the number of measures in 2002 increased from 153 to 221 in 2012, of which the innovation and learning perspective had a rise from 73 measures in 2002 to 151 measures in 2012). At the same time, the importance of the customer and internal business perspectives decreased. The customer approach decreased by 17% (from 12 measures to 10) and the internal perspective by 12%, from 68 measures in 2002 to 60 in 2012. While in 2002 the "growth" measure was clearly the most common published measure, followed by "employee training" and "R&D", in 2012 the most frequently disclosed measure was "employee diversity", followed by "environmental improvements". The highest change in the percentage growth rate occurred due to the measures "social improvements", "employee diversity" and "environmental improvements". Consequently, it was found that considering the innovation and learning perspective, a possible explanation for the great increase in "employee diversity", "environmental improvements", "R&D" and "employee training" measures is the 2003 EU Modernization Directive, although, the legal definition is very obscure.

Their further findings showing that companies have reduced their internal and customer-side reporting activities suggest that companies were more cautious about this type of disclosure, especially concerning internal processes. Neglecting internal business processes in annual reports leads to lower employee engagement, which affects sensitively the company's long-term strategy, ultimately leading to a loss of competitive advantage.

4.2. Serbia

Duric et al. (2010) examined the development of a quality management system based on ISO 9001: 2008 standards and TQM principles in a joint stock company with a complex organizational structure using the Balanced Scorecard method.

They were relying on the company's various reports and statements and their own studies as external observers. The performance measurement of the joint stock company was applied considering the perspective of one of the aspects of the Balanced Scorecard, i.e. the internal processes. The measurement was performed using the key performance indicators (KPI) in line with the Balanced Scorecard concept. They were determined by analysing each process parameter. The analysis of four processes (manufacturing, mechanization, sales, and maintenance) took one month. With the measurement results of the performance indicators (82%, 68%, 74%, 83%), the percentage of the achieved goals was expressed concerning the processes described above. It was found that process executors can positively influence the further development of business processes by reviewing and improving the original decisions.

Consequently the application of the Balanced Scorecard helps the company to learn and improve quality continuously. This results in the customers', consumers', and other stakeholders' greater satisfaction with the products, services, and business system of the company.

4.3. Poland

The Polish survey conducted by Kabalski (2010) had several objectives. Primarily, to present a proposal to the companies concerning the scope and structure of information on their performance made available to the external stakeholders. These are compiled in accordance with the guidelines of the IASB (International Accounting Standards) and the ASB (UK Accounting Standards Board). Second, to determine whether the largest companies listed in Poland provide complete and balanced information on their performance. Finally, to attempt to develop a model for presenting the most appropriate reporting format. To achieve this the IASB and ASB guidelines and the evaluations of reports disclosed by the 20 largest companies listed on the Warsaw Stock Exchange (WSE) were taken into consideration.

The study concluded that, in accordance with international standards, performance reports should take into account all relevant aspects of the company's operation as well as all relevant stakeholders' points of view. To present the company's manifold performance, a logical standard structure was set up that reflects the Balanced Scorecard model. The Balanced Scorecard method is held as an example of a systematic presentation of the information in the report, in which goals, performance, and activities must be logically linked considering hierarchy and causation. The results can be presented both as business (economic) and non-business (social, environmental) activities. This makes it easier for users of financial statements to distinguish between primary and secondary objectives.

The information disclosed by the listed companies was examined in 2009. The analysis sought to answer the following questions: Do companies report their performance from different perspectives? Is there a company whose report can be a model for presenting information about a company's multifaceted performance? The research revealed that none of the twenty companies provide comprehensive records on their performance. Certain companies only disclose mandatory financial statements. Whereas, there are two notable companies that report not only on economic performance but also on their social (employees, customers, community) and environmental performance. However, the author mentions that some companies may be assumed to measure their performance according to his model based on the Balanced Scorecard. Yet, the records appear to be limited and can be considered insufficient to serve as a model.

The author suggests companies on the Warsaw Stock Exchange providing full information on their performance in line with the recommendations of the IASB and the ASB. Thus, it is much easier for stakeholders to make their own assessments of companies.

The results of the studies conducted in Central and Eastern European countries described here are compared in Table 2.

Table 2 Balanced Scorecard analysis aspects and the comparison of the obtained results by examining different nations

	Perspective	Main measures, Indicators	Stakeholder
Austria	Learning and innovation perspective	Employee diversity, productivity, training; accidents; social developments; environmental developments; R&D	Employees, shareholders
	Internal business processes perspective	Growth; productivity	Shareholders
	Customer perspective	Purchase order	Customers
Serbia	Internal business processes perspective	Production, mechanization, sales, maintenance performance indicators	Employees, shareholders
Poland	Financial, customer, internal processes, learning and innovation perspective	Business purposes	Owners, customers, employees, suppliers, community, financial backers
	-	Non-business purposes (social, environmental)	Customers, community

Source: Own construction

The Balanced Scorecard applied by researchers in each country according to different analytical criteria, as illustrated in Table 2, can be summarized as follows.

As for *Austria*, a content analysis method was implemented by listed companies to disclose information. It was grouped into three categories considering three perspectives out of the four of the Balanced Scorecard – customer perspective, internal business perspective, innovation and learning perspective – excluding the financial one. Most measures serve employees' interests, which represents the commitment of employees to strategy. At the same time, shareholders also have an interest in improvements and development if this is accompanied by an increase in sales. Customers are also interested in who is buying from that particular company.

In Serbia, in the case study of a given joint stock company, the Balanced Scorecard was applied from the viewpoint of internal processes. Key performance

indicators were developed in the areas of manufacturing, mechanization, sales and maintenance based on the company's various reports, statements and own observations. These types of analyses are for the satisfaction of shareholders, but the results are also important for employees, as their remuneration may depend on it.

In Poland, content analysis was performed on reports published by twenty listed companies. To this end, a theoretical model was set up based on the Balanced Scorecard. Considering this, the performance of companies should be presented according to 2 main aspects: a differentiation of business and non-business performance indicators. This is to make it easier for users of the statements to distinguish between primary and secondary goals. Business goals include financial, customer, internal business processes, and learning-innovation perspectives, which can be categorized according to different stakeholders.

Non-business activities are subdivided according to social and environmental objectives and serve as secondary activities in the interests of employees, customers, and the community. The information published by the companies was considered insufficient in terms of stakeholder expectations, although if tested in an appropriate environment, the model would have relevance.

5. Conclusion

Nowadays, information compliant with the expectations and needs of the stakeholders of companies is becoming more and more important. This concept has resulted in companies' disclosing statements and reports presented to the public. To do this, traditional financial and non-financial measurement methods are used. Comparing the results of research conducted in a number of Central and Eastern European countries, it can be observed that the Balanced Scorecard can be used to measure the performance of companies by processing the information content of non-financial documents available from external sources.

The Balanced Scorecard can function not only as an internal performance measurement system of the company as well as a management and control tool, but also as a method of analysis, relying on the results of already published information and measures. International studies have shown that the Balanced Scorecard can be used favourably to analyse the information content of operational, i.e. non-financial documents. Using the four perspectives of the Balanced Scorecard, the statements, annual reports and strategic plans presented by the companies can be evaluated separately but comprehensively by external stakeholders and analysts. This way a more informed decision can be made about the performance of the given company. The results of research conducted in different countries confirm that the use of the Balanced Scorecard as an analytical tool supports access to a wide range of information of interest. The literature synthesis reinforces the finding that the Balanced Scorecard is suitable for the analysis of operational results, complementing traditional financial, wealth situation, and income statement analysis. The method bridges the gap between past-oriented financial data and the long-term operational, strategic information (Gácsi et al. 2015).

Among international studies, we have seen examples that by expanding the four perspectives, there is a need to make decisions based on additional perspectives (e.g. environmental or social), which shows the flexibility of the method. All of this seems

to be supported by an earlier assumption. According to it the application of the Balanced Scorecard would be recommended for judging and measuring the social performance of enterprises (Chatterji–Levine 2006). However, performing analyses requires documentation that does not solely consist of financial statements. This depends on the legal environment of the different countries, and the type of documents required to be disclosed. On the model of international research, it would be worthwhile to carry out similar studies in Hungary by visualizing the information reporting quality and content of Hungarian companies. After that the disclosed financial and non-financial information should be analysed from the perspective of stakeholders using the Balanced Scorecard.

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COVID-related disclosure practices of Hungarian entities

Zsuzsanna Ilona Kovács – Edit Lippai-Makra

The pandemic has brought unexpected challenges to businesses as they need to cope with the impact of the virus on their sales performance and face the information need of their stakeholders at the same time. Our study aims to discover the COVID-related risk disclosure practices of Hungarian, publicly listed sample entities in the annual statements prepared for the year 2020. Based on what we have found, the disclosure practices of Hungarian listed entities is quite heterogeneous, there are great differences in the extent of communication with the stakeholders.

Keywords: COVID-related disclosure, non-financial reporting, Hungary

1. Introduction

Even before the COVID pandemic, there had been a consensus about the need to focus more on human well-being when it comes to economic growth (World Economic Forum 2017). Based on the latter source, the idea of sustainable growth entails finding solutions to create enough resources for the present generations without endangering the opportunities of future ones. The report also emphasizes that competitiveness should be considered an important tool in achieving human-centered economic progress by providing the resources needed for well-being, such as *better education, health, and security, and higher per capita income* (World Economic Forum 2017, 9).

1.1. Sustainability in corporate reporting

Based on (Ikram et al. 2020, 2), the consideration of sustainability in corporate strategy and processes is inevitable while coping with the ever-changing business environment and the emerging expectations related to the idea of sustainability. The authors also shed light on the fact that this is a matter of strategic decisions and goes deep into firms' culture (strategy and vision).

The pandemic has formed our economy in ways we have never imagined before and has influenced the operation of businesses in several aspects. As a consequence of the recent spread of COVID around the world, the ideas of competitiveness and the protection of human resources are to be necessarily reinvented by management these days.

According to the World Economic Forum (2020), *human capital* needs to be transformed during the process of revival. The report emphasizes the role of new talent management policies and adaptation to the needs of today's job markets. The COVID-pandemic has also brought light to the vulnerabilities of the healthcare systems and their capacity to deal with such burdens as the consequences of the spread of the virus (World Economic Forum 2020, 6).

From the point of view of the businesses, their survival in the economic slowdown depends on their ability to adapt to the new circumstances and the speed of

their reactions. The safety of customers and staff, the continuity of the supply chain, the methods of keeping in touch with the employees and organizing trainings or recruitment are just a few areas to mention in which the entities had to cope with new challenges.

Competitiveness had already been a complex issue even before 2019-2020 (World Economic Forum 2017). Setting short-term goals and considering the financial consequences of operations has not been enough for a long time now. The notion of sustainability and the concept of the long-term impacts of business operations are ideas that all leaders have to embrace when elaborating strategies for great organizations. Many stakeholders of companies (investors, creditors, employees, customers, and society in general) today care about satisfying the needs of today's generations without harming the opportunities of future generations. Creating enough resources today and still making it possible for future decision makers to continue the task decades later is a great challenge today.

Our research presented in this paper is a pilot project aiming to provide the basis for future analysis. We examine the COVID-related disclosure practices of the Hungarian premium category publicly listed firms. The overall research questions are the following:

What type of COVID-related information is disclosed in the annual statements of the sample entities? How deep is the disclosure? Which topics are addressed?

The paper consists of four sections. Section 1 introduces the topic and provides insight into the difficulties around the inclusion of human resources in financial statements and about the various channels firms use to communicate with stakeholders besides financial statements. Section 2 describes the process of voluntary reposting and presents the results of related international literature. Section 3 presents the empirical study carried out by the authors of this paper, and Section 4 provides conclusion and discusses future research plans.

1.2. Human resources in the annual statements

Human resources constitute a key driver in achieving economic prosperity and productivity, and the development of this kind of capital is based on the following steps (World Economic Forum 2020, 21): sustaining good health for individuals and developing skills and capabilities for them as required by the market.

Neither of these steps are evident these days. Nor is the place of human resources in financial statements as these fall into the category of intangible items and have many attributions that make them difficult to handle from an accounting point of view – at least based on the traditional reporting paradigm (Canibano et al. 2000). The value of human capital is realized by entities and their stakeholders: investors value transparency when it comes to how firms engage in sustainability – green investments are becoming more and more popular and scores based on ESG information (i.e. Environmental, Social and Governance) are reflected in special indexes. However, when it comes to financial reporting, the issue becomes less obvious. Human resources are intangible, they do not correspond to the recognition criteria of the traditional accounting paradigm – they are not controlled by the entities and their elements incorporate high risk in terms of returns, let alone the question of quantifying the value (see Figure 1).

Figure 1 Facts about the Balance Sheet and Intangible Elements

The balance sheet is a part of financial statements that is familiar to all: it has two sides, and it demonstrates the assets of reporting entities and the claims against those assets. The traditional definition of the asset includes: resource presently controlled by the entity that provides economic benefits in the future and has a cost or value that can be measured reliably.

Knowledge assets and other intangible resources have some specific features that make it very difficult to incorporate them in the balance sheet according to present accounting regulations. Problem: entities do not always 'control' them and their 'book value' is hard to measure reliably.

Consequently, financial statements display a very limited set of these kinds of items, although they have a great influence on the success and competitiveness of reporting entities. On the other hand, stakeholders need information on these kinds of resources, so business entities tend to find other ways to supply stakeholders with what they need.

Source: own construction based on (Z. I. Kovács 2015)

Consequently, firms do not have the competence and skills of their workforce listed in Balance Sheets. Traditional financial statements completely lack workforce on the list of capitalized items. This fact influences the quality of information given to the users of financial statements and distorts the picture they get about an entity. That is why the picture given by financial statements needs to be completed by other types of reports. Financial and non-financial reporting provides communications channels to convince the stakeholders.

1.3. Channels of Communication with Stakeholders

Reporting entities are subjects to accounting regulations, and, as a consequence, are required to provide some basic information to their stakeholders. Financial accounting is a methodology that prescribes the amount of information to be provided on a compulsory basis. Besides complying with the standards and giving the required minimum level of information, firms may provide additional details that they consider relevant for the users of the statements.

The financial report is only one of the ways of communication, yet, it has a special status, which lies in the fact that it is created and published in the case of all entities, on a common conceptual basis (the local financial reporting regulations), with regularity. Thus, the role of these reports is outstanding as they can be considered as primary sources of information for the stakeholders. Other reports about ESG topics may include significant information on intangible resources, but these are made on a voluntary basis and do not result in comparable data as they lack a common conceptual basis (there are no globally accepted international standards for non-financial reporting yet).

What is more, according to the most recent developments, integrated reporting is evolving, conflating financial with non-financial. This can bring a lot of challenges but also opportunities: if the same group of individuals work on the elaboration of an information package containing both financial and non-financial information, this can

lead to a better focus and more consistency in reporting. Aligning financial ratios and non-financial key performance indicators in one report can create high value for the users of these integrated statements.

According to a recent survey by KPMG International (2020, 12), 77 per cent of the largest European companies publish social responsibility reports, but the continent is not uniform in this respect. Although the ratio is lower in Eastern Europe, there has been significant improvement over the past three years, while growth has slowed down in Western Europe.

The European Union has recently started placing more emphasis on the issue of reporting ESG information. Directive 2013/34/EU already required entities to include issues related to environmental and social aspects in the management report. In 2014, directive 2014/95/EU amended the already existing requirements to enhance the disclosure of non-financial information by certain large public interest entities, leading all member states to incorporate these rules in their accounting regulations (in Hungary this lead to an amendment in the Hungarian Act on Accounting).

Among the list of topics required to be published by this Directive we can find the following:

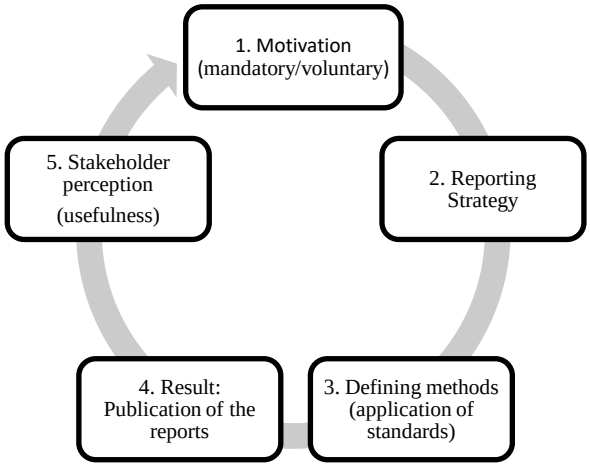
– Health and safety at work
– Actions taken to ensure the protection and the development of the local communities.

The directive also mentions the aim of the development of such frameworks that serve as the common basis for sustainability reporting, setting already existing ones as examples.

2. The process of voluntary reporting

In the following paragraphs, we discuss the process of voluntary reporting (Figure 2). By voluntary reports, we mean the information given to stakeholders outside the four core financial statements: the statement of financial position, the statement of comprehensive income, the statement of cash flow, and the statement of changes of equity.

Figure 2 The process of voluntary reporting



Source: own construction

2.1. Motivation

As a trigger step in the process, some incentives motivate firms to engage in voluntary reporting (step 1). Motivation theories listed by (Shehata 2014) support the notion that motivations exist:

- Agency theory: Voluntary reporting can reduce agency costs (information asymmetry: agent/manager – principal/owner)
- Signalling theory: Voluntary reporting can be used for signalling purposes (entities signal that they are better than their competitors, disclosing more than mandatory)
- Capital need theory: Voluntary reporting helps to attract capital at lower cost – reducing uncertainty
- Legitimacy theory: Voluntary reporting is a method of establishing legitimacy: showing the shared values with society => social contract/earn right to exist

Based on (Ferriani 2020), sustainability data has been increasingly valued by financial investors over the last ten years. The author also highlights that assets that score high on ESG matters attract financing. The reason they mention behind this phenomenon is that the ESG scores reflect firms' ability to internalize the common objective of sustainable development. Investors seem to consider those firms with more ESG disclosure less risky, and the authors also mention a shift in the perspective of ESG indexing from indicators of sustainability to measures of internal vulnerability.

2.2. Reporting strategy

As a consequence of these incentives, entities elaborate their reporting cultures and determine the topics included in the disclosures (step 2). According to Ikram et al. (2020), the COVID-19 pandemic is opening new challenges for corporate sustainability. The authors see the post-COVID-19 era as an opportunity for decision makers to rethink firms' sustainable business practices (including a shift in their manufacturing, supply chain, and sustainability strategies). Based on literature, there is also a great prospect in embracing the advantages that could arise from adapting to the situation:

"Entering into an unknown world, leaders took unofficial steps toward CSR practices that could lead to a strategic competitive advantage. As the world emerges from the COVID-19 pandemic, leaders of organizations should reflect on the positive approaches that emerged. Just as how leaders experienced the benefits of a remote workforce resulting in increased efficiencies due to reduced commuting times with social distancing and shelter-in-place mandates, the increased focus on the organization's true capital – its human capital – may lead to a more sustainable world" (Goldston 2020 5514).

2.3. Standards for non-financial reporting

After considering the motivating factors, there is the issue of whether the firm chooses to follow some kind of reporting standard or guideline (step 3). The difficulty of this decision is caused by the fact that there are multiple standards available, and there is not one favored by the ED either. Petty et al. (2009) believe the most important barrier in

the process of intellectual capital reporting is the lack of consistency of the methods of reporting and the difficulty of assigning relevant quantitative values to the various categories. This issue is also a setback in the area of ESG reporting due to the similar nature of the area (elements are difficult to quantify). However, several standards exist (GRI, IR, SASB) and, in the future, we might see the emergence of a global set of standards in this field.

2.4. Publishing reports

Step 4 is the publication of the reports. An example of how firms incorporate COVID-related disclosure into the existing framework to apply an integrated approach is described by Ikram et al. (2020, 7–8), as the authors list the following as decision sub-categories for Corporate Sustainability after the pandemic:

- Corporate Governance
- Product Responsibility
- Transparency and Communication
- Economics
- Environmental
- Social
- Natural Environment and Climate
- Energy Consumption and Saving
- Pandemic
    - Emergency response plan
    - Commitment to employee safety
    - Just in time and lean delivery
    - Social distancing and employee working hours modification

After the reports are published, the interested parties perceive and evaluate the content of the reports either directly or indirectly, which can create further motivations for entities to continue or adjust their communication strategies.

2.5. The usefulness of the reports

Firms disclose non-financial information because they suspect that users of the annual statements will perceive this information as useful in making their financing decisions. What is more, several studies provide empirical evidence on the connection between the quantity of disclosure on behalf of firms and investor confidence. Ho et al. (2012) studied the Hong Kong exchange to analyze the correlation relation between initial public offering (IPO) of enterprises and the disclosure of intellectual capital components between 2008 and 2010. They found a significant positive correlation between disclosure and investor confidence, which supports that enterprises benefit from communication with their stakeholders.

Boujelbene and Affes (2013) studied listed French enterprises and found an association between disclosure on intellectual capital and capital cost as a dependent variable. The authors also found a significant negative correlation between capital cost and reporting on the two components of intellectual capital (human and structural capital).

Based on our approach, steps 3 and 4 can be investigated by using quantitative methods, for example, content analysis. The advantage of these methods is that they do not require personal contact with the firms, since reports are public in most cases (although in Hungary, the Business Report is considered as an attachment to the annual financial statements, not generally available online, except for public entities). The disadvantage of the method is also obvious: the lack of personal contact means that there is no way to ask questions about the reasons behind reporting. Interviews as qualitative methods can be seen as the most appropriate means of examining steps 1, 2 and 5. These methods can provide deeper insight for the researcher into the motivations and are applicable for collecting information that is not published in the reports. However, the difficulty of reaching out to respondents and finding firms who participate is something we experienced in the Hungarian business environment.

3. Empirical research

In the following paragraphs, we introduce the chosen methodology: content analysis. We also shed light on some of the most important decision points in this type of research and present the preliminary results of our pilot research project carried out on a sample of premium publicly listed Hungarian firms.

3.1. Research aims and methodology

One of our research aims is to discover the reporting practices of sample firms and to know more about how they provide information to stakeholders about the impact of the pandemic on their operations. Another research aim is to gather enough information to elaborate a methodology for content analysis that could be used as the basis of future research. In order to do that, we need to acquire a list of the items of information most commonly disclosed by sample firms. This list can be later applied as a benchmark when we evaluate the reporting culture of firms in a wider sample. By examining the frequency of the disclosed items, we can assign scores to the reports in the sample that can serve as a descriptor of the intensity and quality of disclosure.

An alternative approach could be to apply methodology given in prior empirical research published in international literature (Table 1). In the case of COVID-related disclosure, an example of a method borrowed from international literature could be based on García-Sánchez et al. (2020, 6). The advantage of applying a methodology that had already been published provides some degree of opportunity to compare our results with those of other researchers. However, based on our experience (Kovács–Lippai-Makra, 2018, and Lippai-Makra et al. 2019), the process of human coding of annual statements is a very delicate one as there needs to be a common understanding of the items in the list to be searched for. A way to combine the advantages of both elaborating the researcher's own index and still relating to international literature is to select a methodology from a paper authored by other researchers, and ,after running the content analysis based on this method, invent a modified version that considers local circumstances, similarly to Deutsch and Pintér (2018).

Content analysis combined with a list (index) of items to look for provides a more formal output than case studies and offers an opportunity to run statistical tests on

the results and to discover any explanatory variables that influence the disclosure practices related to the given topic (in this case the pandemic). The ultimate goal is to gain a better understanding of the motivating or explanatory factors behind Hungarian reporting culture.

An example of similar research is Irimuș (2020), where 2019 annual reports were used to analyze how firms choose to incorporate the coronavirus outbreak in their reporting process (on a sample of 30 entities from the FTSE100 index). The author chose the dependent variable as the references to the coronavirus pandemic in 2019 annual reports. The variable COVID was constructed by performing text analysis of the hand-collected 2019 annual reports. The author then applied a linear regression model and found that financial year influenced the Covid-19 disclosure, with companies publishing their annual reports after the date of 31 December 2019 having significantly more content added to the statements.

After considering the above options, we chose to count any references to COVID ('COVID', 'coronavirus' or 'pandemic') in the 2020 annual statements of the sample entities. We also determined the number of instances the pandemic was mentioned in the various parts of the statements to get a picture of the distribution of this kind of disclosure in different statements. The focus of this paper is to develop a research tool and to gain an understanding of the most commonly reported COVID-related issues within the sample. We do not aim to generalize the results at this point of the research, but rather consider this work as an important step of the process to evaluate larger samples in the future.

3.2. Sample and results

The reason for choosing premium category listed entities[1] for the sample of this pilot project is that based on earlier research, we know that these tend to communicate more – both in quantity and quality – with their stakeholders in their annual statements than non-listed firms, i.e. they are more engaged in voluntary reporting (Kovács Z. I. 2015). At this level of empirical research, our pilot test was carried out on a sample of 20 entities from the Budapest Stock Exchange for the accounting year 2020 to ensure that the most recently available sources of annual reports were processed. The sample includes firms from several sectors, including manufacturing and service-based companies as well as financial institutions.

The average occurrences of the terms we searched for can be seen in Table 1. The term "Covid" was mentioned on average 17 times per statement. However, there is great variance in the frequencies as the minimum is 3 and the maximum is 57. The term "Coronavirus" was mentioned on average 6 times per statement, the minimum being 0 and the maximum 26. The term "Pandemic" was mentioned on average 7 times per statement, the minimum being 0 and the maximum 51. In total, the three terms were mentioned on average 31 times per statement.

[1]Entities of the prime market are more liquid and have broader ownership structure according. Source: https://bse.hu/Products-and-Services/Equities-Section/Equities.

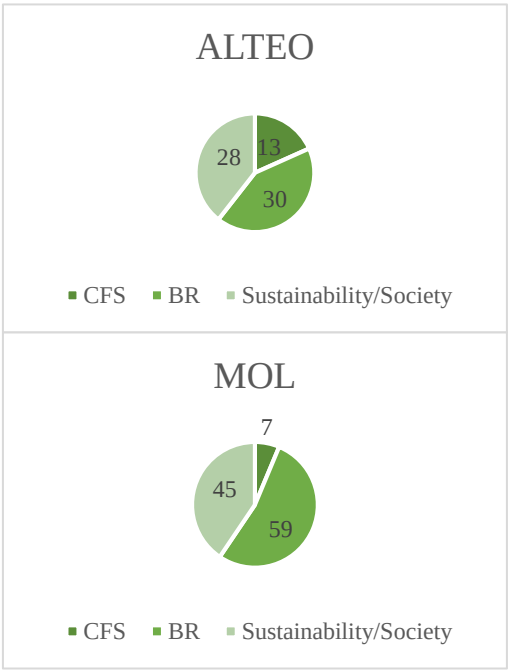
Table 1 Statistical data related to the disclosure of different COVID-related phrases

	Average	Min.	Max.	Median
Covid mentioned	17.25	3	57	11.5
Coronavirus mentioned	6.4	0	26	4.5
Pandemic mentioned	7.25	0	51	1.5
Total	30.9	5	111	22

Source: own construction

We also counted the instances that the above three COVID-related phrases appeared in the various sections of financial statements. In the sample, we have found two integrated statements, which contained the financial statements and different chapters for sustainability of society-related issues. These two statements ranked high in terms of the number of pandemic related disclosure items (111 and 71 in total, ranking 1st and 3rd place in the sample). The distribution of the disclosures within the parts of these integrated statements can be seen in Figures 3 and 4.

Figures 3–4 The distribution of the disclosures in IRs



Source: own construction

For the rest of the sample (18 entities who did not disclose integrated financial statements), we examined the distribution of the disclosure concerning the coronavirus. The average number of disclosures was 14 for the financial statements part and 10 for the business report sections (Table 2).

Table 2 Statistical data related to the disclosure in different sections

Sections of Reports	Average	Min	Max	Median
Financial Statements	14.11	5	55	11.50
Business Report	10.11	0	25	6.50
Total	24.22	5	80	21

Source: own construction

We can also see that there is a great variance in the disclosure scores since there is a large gap between minimums and maximums. In order to investigate the reason for these great differences, we would probably need to expand the statistics looking for variables that affect disclosure or employ qualitative research methods such as interviews.

Besides the above mentioned statistical data, it is worth mentioning which topics were typically addressed in the statements related to COVID. The following list provides the most common examples of the footprint of the pandemic in annual statements:

- global/industry environment, recession
- reactions to pandemic
- EBIT/EBITDA/CAPEX/revenue
- going concern
- rental contracts
- growing demand, inventory management
- supply chain, global movement of goods
- impairment and fair value estimations
- employee & customer safety
- testing of staff
- home office, traveling, road safety
- meetings, trainings, recruitment, events, marketing, trials online
- delay of plans, projects, maintenance
- donations.

What is more, some of the firms shed light on the positive side of adapting to this unique and difficult situation. An entity highlighted the decision to enter a new segment related to the pandemic and listed a series of impacts accordingly.

4. Conclusions and limitations

As we can see, the disclosure practices of Hungarian listed entities is quite heterogeneous, there are great differences in the extent of communication with the stakeholders. Some entities also grasp the advantages that derive from coping with the difficulties, which is in line with what is suggested in the literature.

Sample size is an underlying limitation of the research. In the future, additional results could be obtained by enlarging the sample which would make it possible to find variables (e.g. profitability, firm size, ownership structure) that might explain the differences in disclosure scores. Another way of continuing the research could be the

application of other methods: qualitative research could definitely be useful for discovering the motivations and barriers behind the reporting culture.

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Developing new business models from a controller perspective

Károly Szóka

The Fourth Industrial Revolution and its effects, the pandemic and the new market trends that are emerging as a result, pose significant challenges for companies. Flexibility is no longer enough, adapting to digitalization, developing a new business model using an integrated work environment and self-service business intelligence are needed. The controller plays a key role in this process, as a business partner is actively involved in building the models. The controller has several new or refocused tools at their disposal, such as multidimensional decision-making procedures, digital reports, scenario analysis, specialized KPIs, and more. This study reviews how these tools can help shape a new business model, and how this digitalization can help.

JEL codes: D24, D81, M10, O10

Keywords: Industry 4.0, strategy, change, new business model, digitization, controlling

1. Introduction

Industrial revolutions have strongly transformed the world economy (among other things). With the 4th Industrial Revolution, we have entered an era of ubiquitous technology, digitization, personalized mass production and social media; the classic large steel producing companies have been replaced by high-tech transnational corporations. The process and technology of traditional manufacturing is undergoing a major change, with new business models emerging. These are due to trends such as urbanization, individualization, digitalisation and demographic change. As in the case of previous industrial revolutions, the standard of the industrialization process of the 4th Industrial Revolution is dominated by technical, technological innovations and the already mentioned giant companies (Bartodziej 2017).

With the completion of the 4th Industrial Revolution, Industry 4.0 has high expectations and challenges for businesses, which COVID-19 has even added to. The ongoing pandemic has caused a crisis that everyone has experienced, and certainly its effects. In addition to the many worries and negative effects, a positive one can also accelerate the spread of Industry 4.0 techniques and technologies. This new coronavirus, SARS-CoV-2 , is not just an economic problem, as it destroys human lives and has social implications to this day. Its effects and consequences are still unpredictable today, but it has certainly had a significant shock effect at all levels of the economy and society, including the lives of businesses.

In managing these effects and consequences in the business, the controller is one of the key figures, whose task is to identify and evaluate business changes and trends. It is safe to say that the role of controlling has increased again. There are plenty of planning and analysis methods that a controller needs to know and apply, a good few of which have come to the fore again. In this study, I review the characteristics of new business models emerging because of digitalization and the planning and analysis tools that can be used well in this period.

2. Features of Industry 4.0

Industrial revolutions always change the structure and composition of the economy, affecting everyday life as well. Today, after the appearance of the loom, the golden age of heavy industry, through the heyday of the oil industry, we have entered a period of technology and social media that is almost interwoven and dominant (Koloszár–Németh 2020). In Industry 4.0 processes, the production processes are optimized and digitized (e.g. production, logistics, quality management, maintenance, etc.) all real time can be tracked. Industry 4.0 is also called megatrends, with the goal of creating intelligent, networked factories (value-creating chains) that enable more efficient, yet personalized manufacturing. The digitization of the operation of machines allows their operation to adapt dynamically and automatically to ever-changing orders and conditions.

At the heart of the system is the ability of production and the machines to recognize themselves the events and change their operation accordingly. Thus, the main features of the new industrial revolution are horizontal integration and end-to-end integration of manufacturing throughout the value chain, as well as the development of vertical integration and networked manufacturing systems. Plants, products and machines communicate with each other via software, so that the processes – at least – partially regulate themselves (Szóka 2018a). Today's market trends and tendencies pose significant challenges for companies. Renewal of technology can bring the expected results by transforming and coordinating structure and processes, but this is a company-wide process which, therefore, has a high-risk challenge (Koloszár 2013). Corporate processes are changing in the global economy that is accelerating from year to year, which means that our dependency on globality is becoming more and more solid. As a result, effective company management is receiving more attention (Pankotay 2017). Moreover, flexibility alone is no longer enough today, intelligent and "learning factories" need to be built. Adapting to digitalization, using an integrated work environment and self-service business intelligence, a new business model needs to be developed (Szóka 2019).

3. Controlling today

The development of controlling and controlling systems took a long time, first the operational procedures and methods, then the strategic controlling system were developed. One of its characteristics is that it is constantly changing, but it can be said that it has a methodology based on a standard approach and well-defined tools (managerial accounting, investment valuation, planning tools, reports, etc.) (Zéman et al. 2014).

We now encounter controlling functions and controller roles in every company. The controller's work has its own unique approach and functionality, as well as a toolbox. The task of controlling is to provide the management with analysis and advice, so they can keep the economic aspects in mind maximally while making decisions (Kovács 2017, Fenyves 2019). According to the joint 'Basic Principle' of Internationaler Controller Verein and the International Group of Controlling, controlling is a decision support management activity in the field of goals and expected impacts, with planning, calculation and control subsystems. According to Deyhle,

quoted by them, controlling is a set of goal-oriented management activities, a continuous cooperation between controller and company manager, applied calculation methods and other soft factors (Internationaler Controller Verein, International Group of Controlling 2012). The basic philosophy of controlling is to lead the company towards (increasingly) successful operation through its activity. The way Deyhle put it, only a business where management proactively designates the path it wants to follow will be successful, and if that does not work that way, we will just react to events (Deyhle 2005).

Since 2010, the higher level of the controller role is the business partner. This means that the controller is an accepted partner of managers who participates in management and decision-making processes and is expected to behave proactively. Not only do they support decision-making and take responsibility for achieving the set goals, but they also have decision-making power. The tasks of the controller as a partner is not only to perform the calculations, explain and communicate the differences, but also to support the launch of the actions and monitor their implementation (Fenyves–Tarnóczi 2019).

Digitization is not only a change in competition rules; it can also be an opportunity to take off. To do this, we must first recognize that we need to reap the benefits of digitalisation through innovation such as open innovation, shorter decision paths, lean (start-up) thinking, etc. In performance measurement, traditional KPIs are generally not applicable in the digital business model, so an appropriate measurement system needs to be developed (see below). We need to think about which processes work well and which do not. We need to know which processes can be digitized in the first round, and what we will only be involved in later.

We need to know what resources and conditions are needed to achieve the goal we want to achieve, and how much they cost. Training and retaining a skilled workforce is no longer an issue today, "new hiring is retention", as the saying goes. Digitization, the digital switchover requires a skilled workforce and IT skills.

The next level of controlling reports is Forecasting 4.0, which uses predictive analysis methods and advanced statistical algorithms to produce highly automated forecasts using statistical algorithms that analyze large amounts of data. Forecasting 4.0 takes into account not only company internal data, but also external and poorly structured data and expert reports, as they contain additional information (e.g. detailed market traffic data, weather forecasts, accurate regional statistics, social media data, etc.). This is realized in the interaction of human vs. machine, in addition to statistical forecasting, it also leaves room for expert intervention. During forecasting, machine forecasts and trends can be distinguished, and expert – that is, human – corrections that may override this. By using this, the compulsion to act increases within the company, it can react more actively to market effects, we get proactive analyses instead of analytical-reactive ones, and due to the high automation the preparation, time is reduced to a minimal level (Gulyás 2017).

4. Emergence of new business models

Digitization has brought great changes. In smart factories, intelligent manufacturing systems and processes are interconnected, and communication is the key to their operation. An important change is the decentralization of processes, the flexibility of production and continuous improvement. Digital processes only work if the processes are clearly defined. To do this, detailed process models need to be developed.

An end-to-end approach is emerging, the fulfillment of customer requirements (such as an order) must be monitored throughout the company, and automatic execution must be ensured. Process measurements and reports become automated, as all the necessary data is available. The risk is much lower, and there is no change management, as robots and computers execute instructions accurately and do not need to be convinced of the correctness of this change, so there is less chance of error (Bergsmann–Brenner 2018). Digitization will also affect organizations and working methods, departments and divisions will be eliminated, there will only be roles, jobs, teams and projects. This process will bring about a complete transformation of our economic life, the ever closer interconnection of information technology and automation, resulting in a radical transformation of production methods. With machine-to-machine technology (M2M), machines can also control more complex processes based on the ability to communicate with each other without human intervention (Cseh–Varga 2020). These effects can and need to be countervailed by the initiation of new types of revenue tariffs. These new taxes will not oppress living labour but will either mean newer consumption-traffic taxes or charge the process of automatization. In this way, the dignity of human workforce can be raised by it being free from its tax (Varga–Cseh 2019).

Industry 4.0 means a high degree of product and process variability, which increases the complexity of continuous cost control. Therefore, operational production control, and thus ongoing cost control, becomes even more relevant. The biggest challenge is collecting and verifying cost information at place of value creation, and summarizing and analyzing it into customer-specific modules. Due to the characteristics of the new model, the direction of production management and the method of cost control will change. Instead of the cost of a single piece and the cost of the manufacturing process, it is also necessary to consider how networking the different modules contributes to adding value to the customer.

Instead of one-dimensional decision-making procedures (e.g. optimal capacity utilization for fixed costs), multi-dimensional decision-making procedures are used. The baseline situation and variables are unclear and difficult to quantify, so no clear decision can be made, customer behavior and market reactions must be taken into account. Thus, the same manufacturing processes sometimes show different production costs, because of which the cost structures of digital business models differ significantly from the cost of classic business models. Economic viability (profitability) depends less on the cost side of goods and services (production costs) and the price available on the market (margin), but more on the scalability of the evolving business model (intensity, duration) and business model (Szóka 2018b). It is not easy when multivariate functions need to be incorporated into planning and control models due to customer (or customer group) specific price-selling functions. Dynamic pricing changes goal calculation, and increasing individualization modifies this process. The benefits of Big Data are

immediately apparent in classic quality issues, with sensors (see RFID technology) helping to identify unusual manufacturing conditions at an early stage, thereby predicting potential production downtime, quality defects or other problems (Oehler et al. 2016).

For many companies, this new business model is very different from the old one, as people today buy a service rather than a product. People do not want to own it, just use it for a short time while it is needed, so they do not want to pay for it anymore because they no longer use that device or service. They do not buy a car, they just rent and travel with it, or they do not buy a music album, they just stream music. Of course, this also affects the companies that produce and sell them, which also changes the structure and processing of the data.

If we want immediate and accurate reports, the focus shifts from plan-to-fact comparisons to plan-forecast discrepancies. This requires the automation and robotization of processes and routine work (Robotic Process Automation, RPA). Once we have the database, we can add a user-friendly and self-service BI tool that allows non-controller users to perform analyzes with relatively little IT knowledge. This enables automation of analyses, reports, and the databased decision-making. In this phase, the role of the controller is finally transformed: from the role of data collector and processor to the role of the business partner as a service provider, i.e. it will truly become a Business partner.

The pandemic also affected organizational culture, including a definitive change in our work habits. The introduction of the home office and 1–2 days of work-attendance per week seems to have been integrated into the life of companies in the end. Fewer offices mean lower costs, which can support the purchase of equipment for working from home, as well as increasing flexibility, which of course entails HR and organizational tasks. Where a professional and trust network operates, the company does not suffer from this kind of change.

5. Applicability of planning tools in a changed business environment

There are currently several trends in connection with forecasts and reporting expectations. One is to change the corporate governance system and the related reporting from reactive to proactive, the other is data integration, and the third is digitization. Proactivity is aided by predictive analysis and the use of statistical methods and models. Using them, we can make well-utilized findings from various data sources, and we can make valuable predictions. Based on characteristics, we categorize the available data and, based on past behaviour, we assume a future behaviour. The more known factors (predictors) we have, the more likely the planned outcome will be.

We have less and less time to produce digital report data, and shorter and shorter management cycles require centralized, real-time information, so one of the challenges is to bring reporting and decision closer together, and for this situation-specific KPIs must be identified (Szóka 2019). As a first step, we determine the KPIs that we want to model (e.g. EBITDA, Cash Flow).

We determine the factors (inputs) that affect this KPI – these will be the drivers. Using a sensitivity analysis, we examine how these factors affect for KPI, but note that several of these factors may change at the same time. We then analyse the risk factors

and their probability of occurrence and impact on the KPI. Both drivers and risk factors are industry and organization specific, there is no general scheme. After simulating the expected value of the KPI, business responses should be given in light of the results obtained, i.e. actions should be formulated to achieve the strategic goal of the company (Gulyás et al. 2020).

Instead of the classic budget planning, it is recommended to use short scenarios, driver-based scenario planning supplemented with risk analysis, advanced forecasting, or zero-based budgeting. The reporting frequency of the most important KPIs should also be increased; the extra time required for this can be solved by reducing the number and length of meetings. (The controller should not sit in online meetings and webinars all day.) We have to think all the way through how we can build the integrated database that is needed for a good forecasting model; where, how and in how long we obtain internal and external data. It is recommended to integrate scenario modelling into the normal performance management process, shorter-term but more frequent forecasts and performance measurements should be made part of everyday life. If necessary, the product and service portfolio and thus our processes must be adapted to the needs of customers in the new era. It is certain that there will be a greater demand for products supported by digitization services (Tobias–Wenning 2020).

The method of scenario analysis has been known for some time, but some aspects of it need to be modified. On the one hand, it should not only be project-like (as before), but we need to build it into performance management processes, and on the other hand, we need to ask for the support of senior management. This will not be easy, as this method will create long-term and qualitative visions that seem too theoretical. A scenario analysis will be good if we focus on the business causes and measures, their effects and causes can be seen in it. We need to create a baseline (realistic scenario) with existing data and forecasts and modify it to get the alternatives. Variables (drivers) can be volume, capacity utilization, sales, variable costs, and so on. To this we match the second level, what investments are running (with what costs, consequences etc.), and which we will stop if necessary. We map the financial impact of each measure, show how it appears in the scenarios, and determine where the threshold is if it is exceeded, intervention is initiated. This scenario modelling offers a competitive advantage to the company, better decisions can be made faster, and the focus will not be on the present but on the future. Using this, the controller is able to play the role of a Business Partner and emphatically participate in management meetings (Kappes–Klehr 2020).

6. Trends and expectations

It was necessary to move from managing in a previously stable business environment to adapting to a hectically changing environment. Experts interviewed at the IFUA conference in November 2020 were divided, some saying the old days were coming back, others saying that nothing will be the old. (85% of voters say the situation will not be resolved by mid-2022.) There is still no consensus whether the pandemic has been a one-off shock effect or a trend reversal.

In my opinion, digitization, virtualization, automation, artificial intelligence have become part of our lives, new buzzwords are digitization, cost rationalization,

review of cost structures, implementation of structural changes, and increasing employee engagement, companies are willing to invest in these. In the scenarios, almost every medium or large company includes extensive digitization, for which, of course, all activities and processes must be examined.

Organisational culture and behaviour are key factors for TQM, Lean M or LSS, and the borders overlap. Pankotay points out that management, employees and operational performance are closely linked to lean culture. Culture, trust and relational capital are now the cornerstones of cross-border work organisation (Pankotay 2020).

Cost rationalization is also important, but cost cutting should not be confused with cost saving. Cost cutting is only possible for a short time, the execution of customer orders at the expected quality level, and its satisfaction after the crisis, when the market returns to such a low cost level, it can no longer be implemented at an appropriate level. Having no maintenance or training for a short time is workable, but it will backfire in the end, efficiency will deteriorate, machines will break down, and so on. It is certain that bottlenecks need to be investigated, even those that do not yet exist but may arise in the event of collusion under certain circumstances, and an appropriate scenario needs to be developed for these situations. Negative margin products, departments, stores, directions must be separated. The (company and product) portfolio clean-up has started, the companies are focusing on the core activity (Horváth & Partners 2020).

7. Conclusions

Industry 4.0 is already a part of our lives, the change and its pace is enormous, development is dynamic everywhere, it is difficult to predict what planning and analysis tools we will use in, say, 1–2 years from now. As the saying goes, only in trouble can we see who our real friend is, we have seen in a crisis why it is so important to have a good controller or a well-functioning controlling system.

The speed of the system, and of course the speed and flexibility of the decision-maker, has now become key, and digitalisation tools can support these. Many new, breakthrough "digitization" techniques have emerged in recent years – it is enough to think about mobile data entry and reporting or Big Data and data mining. There is a consensus in the industry that the opportunities offered by the crisis should be seized and treated as opportunities, and that strategic, long-term developments should be implemented, and the focus should be placed on the right place.

The saying 'Cash is King' has become popular again; a crisis is a crisis, so the daily liquidity position is an important factor everywhere. Several planning and analysis tools that have been known for a long time have reappeared, but they can be used well in the given situation – again, we use and modify them boldly.

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Challenges of Industry 4.0 in Hungarian agriculture

Enikő Lencsés – Kornélia Mészáros

Although the technological revolutions in agricultural production are already at stage 5.0, the majority of Hungarian farmers are familiar with the achievements of 4.0 in theory, but most of them still use only elements of stage 2.0. The range of BigData applications goes far beyond production itself and even covers the entire supply chain. It plays a role in global issues such as food safety and sustainable management, and the results of the data from the system are used to improve efficiency. The development of the Internet of Things (IoT), which wirelessly connects agricultural production and supply chain members, will result in a lot of new, real-time data. An important challenge for these changes is to create new business models for farmers, but it also brings with it a number of open regulatory issues, such as data security and data ownership issues. Decision-making issues do not necessarily remain in the hands of farmers, but the data owner can have a major influence on the design and selection of alternatives. Sustainable integration of Big Data resources is a challenge, as it is crucial for the enterprise model. In order to introduce and apply new technologies, it is absolutely necessary to rethink and transform the existing processes. Developments should not be done in isolation, but together with innovative companies and farmers. It is important to keep in mind that in the future, the collection and sharing of data and the different work tools will be compatible with each other, and data transfer will be as simple as possible, keeping security in mind. The present study examines the theoretical effects of BigData applications in comparison to business models used in conventional technology along the business model research issue based on Lindgradt et al. (2009).

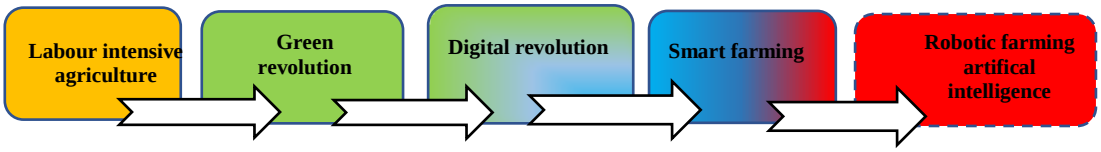
Keywords: Big Data, IoT, business model, agricultural innovation

1. Introduction

Numerous global trends are influencing agribusiness. Agricultural production needs to face the following main challenges: a growing population, increasing urbanization, climate change, and technology change. We are in the middle of new agriculture revolution. The stages of the agriculture are the following (Kovács–Husti 2018, Lejon–Frankelion, 2015, Popp et al. 2018, Rose–Chilvers 2018, Varga 2018, Lencsés–Mészáros 2021), (Figure 1):

1. Labour-intensive agriculture: low productivity, enough food for population, and 1/3 of the population needed to work in the agriculture.
2. Green revolution: the adoption of new technologies such as yield variety, chemical fertilizers, agro-chemicals, irrigation, and new methods of cultivation, including mechanization. The key leader was Norman Borlaug.
3. Digital revolution / Precision farming: variable rate technology, site specific decision, GIS, GPS
4. Smart farming: big data, cloud based, on-line sensors, UAV.
5. Robotic farming: robots used in agriculture production, e.g. spraying drones, and weed-management robots. These technologies are still under development.

Figure 1 Technology revolutions in agriculture production



Source: Own construction based on: Kovács–Husti (2018); Lejon–Frenkelius (2015); Popp et al. (2018); Rose–Chilvers (2018); Varga (2018), Lencsés–Mészáros (2021).

Agriculture in 4.0 is still at an early stage of development, mostly used in Western Europe and North America for the time being. Within Agriculture 4.0 technology, BigData applications can be used on issues such as food safety and sustainable farming, and the results of the data from the system play a role in improving efficiency. The development of the Internet of Things (IoT), which wirelessly connects agricultural production and members of the supply chain, is creating much new, real-time data and making it available (Wolfert et al. 2017).

However, the new technology presents a number of challenges, to which Szőke and Kovács (2020) drew attention. Efficient processing of large amounts of data still involves problems. Broadband internet is not yet available everywhere. Data from different manufacturers are not compatible with each other, so data transfer between systems is not guaranteed. The quality of the data collected also varies, which poses a different kind of compatibility issue. The application of new technology requires the acquisition of new skills, which is time-consuming and requires the organization of trainings and courses. There is a need to create and apply new business models. Analyses of unprecedented size and speed change the opportunities for participants in the production process and create new business models. Management of the economy, access to data, real-time forecasting and monitoring, combined with developments in the IoT, will manifest themselves in further automation and autonomous operation of the economy. It can already be seen that Big Data will cause a significant rearrangement in the balance of power between the actors involved in production. When using Big Data, a lot of heterogeneous data is also a big challenge to apply to intelligent processing and analytics. Sustainable integration of Big Data sources, data sources are a challenge as this is crucial for the corporate model (Wolfert et al. 2017).

There may be other barriers to the diffusion of technology. Fodor et al. (2020) approached the issue from a legal perspective. One of the biggest barriers to innovation in Hungary is the unfavorable legal regulatory environment, which includes bureaucratic and thus cumbersome administration, lack of financial resources and skilled labor, is less open to innovation management, and has the problem of knowledge transfer. The unfavorable legacy of previous periods has resulted in a still tangible, disorganized environment, such as an increasingly aging farming community, large-scale tenure, undivided common property, a lack of agricultural co-operation, and incomplete regulation. The process of transformation at the time of the regime change was followed only by a significant delay in the emergence of innovation, which was created through the EU support system.

Assessing the Hungarian situation, László Farkas (who is a pioneer farmer of precision farming) also highlighted the regulatory environment as a factor hindering new technologies and making it difficult to catch up with developed countries. The other hindrance is that it is difficult to implement development without external help. Using expert advice, it is necessary to optimize it for the processes of the given economy, for which one of the best solutions is precision or smart technology. In addition to using expert advice, Szilárd Szabó emphasized his commitment. Appropriate calculations for investment costs are now available, the return can be limited, but in a large company, a lot can depend on the attitude of the employees. The application of new technologies is a step-by-step process in which planning, construction and education also have a place (Agronapló 2018).

NAK (2019) conducted research among precision farmers, which we believe also suggests the spread and use of smart technology. The concept of precision farming is well-known among Hungarian farmers engaged in crop production: 79% have heard of it and know what it means, and 61% are open to the use of precision technology tools. Other studies show that only half of crop growers have heard of it, but this percentage also depends on the size of the farm. Users of precision farming are mainly under 40 years of age, have a tertiary education, and cultivate more than 300 hectares of land, which is in line with international experience (Lencsés et al. 2014). 23% of farmers actually use some element of precision farming. Of those who do, 79% are satisfied with it. The most common precision devices are GPS 58%, guide 47%, and automatic steering 24% (NAK 2019). However, according to a survey by Pólya and Varanka (2015), 44% of all farmers use GPS, while 48% of the farmers under 40 years of age do so.

Of the control systems, 30% of weeds follow a robotic pilot, followed by VRT sowing and fertilizer application (25%). The use of anti-pest sensors, drones, and precision irrigation sensors is still in its infancy: their application rate is only around 5% (Kemény et al. 2017). Regarding future plans, most farmers would introduce drones (13%), RTK (real-time kinematic systems, 13%) and automatic steering (12%).

The survey by Berta (2018) contradicts all this, where 63% of agricultural entrepreneurs do not use GPS, 16.3% use it only on a power machine, and 20.7% on a power and work machine. And there are problems for entrepreneurs in accessing precision data. In the survey, 39 farmers used the data analysis option, so the numbers are extremely low. Of this, 51.2% retrieve the data themselves, 14% access it with assistance, and 34.8% have it sent to them. All this points to the fact that only a small proportion of farmers are able to use digital technology related to precision farming. Thus, it is thought-provoking that the application of smart systems is less successful than it would be based on data extraction and analysis.

However, the results of the survey are nuanced by the fact that two-thirds of farmers stated that they use at least one of the technologies described. Based on this, the question arises as to whether some farmers are either unaware of precision technology or their actual use is not considered precision farming (NAK, 2019). Takácsné (2015) segmented farmers in terms of the application of technological innovation. They can be basically divided into two major groups: innovators and early adapters actively involved in innovative developments, and those who use mature technology, that is, pragmatic early adopters, late conservatives, and late sceptics.

Lencsés et al. (2014) pointed out that the biggest problem of the interviewed farmers depends on the professional knowledge and attitude of the manager and staff to a great extent. Because of this, farmers sometimes think that investing in precision technology will not bring the expected positive results, so they do not buy other accessories or start using their precision tools in the traditional way. Takács-György and Takács (2011) highlighted high investment costs as a limiting factor. As a result, farmers do not dare to embark on a change in technology. According to their studies, the risk is in the different prices of input and output materials, in the production structure, in the yields of precision farming in different areas, and in the size of the plant. In another study, Takácsné (2011) points out that in areas with homogeneous conditions, the return on investment takes more time, as no significant material cost savings can be achieved. Takácsné (2015) also drew attention to the fact that different technological elements belonging to precision technology run different life paths. This is due to differences in technological developments and differences in their "palpability" in their application. Significant improvements in pest control are still expected in the identification of pests or the refinement of remote sensing.

Several studies highlight the importance of expertise (Gaál–Illés 2020; Takács-György–Takács 2011). Farmers using new technology need to have a complex body of knowledge that is less popular due to its novelty, with the older generation refraining from using it. Computer skills are required to manage smart machines and systems, and to extract the data from them. This can be helped by the organization of various trainings, the involvement of agro-informatics in the extraction and proper management of data, and the operation of the expert advisory system in this direction.

2. Model and method

Osterwalder et al. (2005) describes value configuration as the arrangement of activities and resources. Core competency includes the competencies necessary to execute the business model. Partner network refers to the network of cooperative agreements with other companies necessary to efficiently offer value. The business models of competitors could be completely different. A competitor who selects the best model and implements it effectively can win the trade and competition. The different reasons could force the organizations to change their previous business model. Investments and innovations, information systems, human capital, and new technologies are some of the numerous examples of business model innovation driving forces. Of course, the aim of agility is not just to inactively respond to the environment changes, it is also to take advantages of changes (Dove 1994, Kidd 1994, Sharifi–Zhang 1999).

Innovation in a business model does not simply mean the innovation in services/products or technology (Lindgadt et al. 2009, Massa–Tucci, 2013, Mitchell–Bruckner 2004). Lindgardt et al. (2009) believe that when innovation in a business model occurs at least two components are reinvented, and innovation in just product/service does not count as a business model innovation. According to them, the two main elements of the business model are the value proposition model and the operating model. The value proposition model includes the following components: target segment, products/services offering, revenue model, operating model, comprises value chain, cost model, and organization. Innovation in the business model has been

always recommended, due to the fact that sustainable competitive advantage is created in business model innovation (Giesen et al. 2007, Mitchell–Bruckner 2004). Massa and Tucci (2013) also argue that business model innovation consists of innovation in content, structure and governance. Innovators need to dynamically trace the trends and to have a proper change management to be able to respond on time to these changes (Mitchell–Bruckner 2004). Of course, the aim of agility is not just to inactively respond to the environmental changes but to take advantage of changes (Sharifi–Zhang 1999, Dove 1994, Kidd 1994).

According to the Lindtgard model, we examine all the necessary elements for the introduction and professional application of agriculture 4.0 and compare them with the practical experience from Hungarian surveys. This way we can identify the factors where improvement is needed.

3. Results

We summarize our results in Table 1, which highlights which points according to the Lindtgard et al. (2009) model should be met in the case of agriculture 4.0, and where the current Hungarian general agricultural practice is. As the table shows, change is needed in all elements, not only in the use of the new technology, but also in gaining background knowledge related to the technology and connecting more closely with members of the value chain.

Table 1 Changes of business model element by Lindgardt et al. (2009) due to the adaptation of Agriculture 4.0 technology

Components of business model	Agriculture 4.0 requirements and effects	Missing factors in case of Hungarian farmers
TARGET SEGMENT	B2C: conscious food consumer with moderate environmentally friendly attitude who wants to know how to trace the source of the food B2B: agrobusiness sector (for whom the comprehensive system of traceability is very important)	Most farmers do not know the final consumer and their needs. Aim: understand the costumer behaviour
PRODUCT OFFERING	Agricultural products e.g. crops, vegetables, fruits.	Farmers do not want to give their data to the buyers. Aim: improve the trust in the supply chain.
REVENUE MODEL	With Agricultural 4.0 technologies the yield and income volatilities become less general because of the more rational input usage.	The data goodness mainly depends on the IT knowledge of the person who analyses the data. Aim: improve the IT knowledge of farmers

VALUE CHAIN	The last agricultural revolution does not make changes in the value chain.	Without the trust between the members of the value chain the system does not work.
COST MODEL	According to FADN, cost structure included crop-specific inputs, total farming overhead, depreciation of capital assets estimated at replacement value, and total external cost.	The farmers must understand the connection between the costs and the benefits. Aim: help the farmers understand the importance of cost analysis.
ORGANIZATION	The Agriculture 4.0 technologies are very sensitive to the digital skills of the staff.	The employee in the agricultural holdings is not well qualified or well educated. Aim: improve digital skills and help deepen commitment to new technology.

Source: own research

4. Conclusion

Hungary is not lagging behind the developed agricultural countries (like Denmark, Germany, USA, etc.) in the availability of latest technologies (like, for example, spraying drones). All the latest innovations are available for Hungarian farmers. It is very positive that the average Hungarian farmers have heard about the equipment of Agriculture 4.0 and they know a lot about its theory,but for some reasons they do not use these innovations. If the government wants to extend the adaptation of Agriculture 4.0 in Hungary, they need to make an effort in the following fields: improve trust in the value chain, improve digital skills of farmers, and give financial support to farmers who use modern agriculture equipment.

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Overview of European patents in Germany, France and Spain, with a potential application to the development of electric vehicles

Boglárka Konka – Anita Veres

Within the Green Deal's 'Accelerating the shift to sustainable and smart mobility', vehicles with alternative propulsion systems will play a significant role, as the transport sector is responsible for one-fifth of the European Union's CO_2 emissions. Therefore, more and more governments are supporting the purchase and production of electric vehicles, as it can be one of the main tools for locally reducing fossil fuel consumption as well as reducing CO_2 emissions. The analysis highlights that the three most important vehicle-producing countries (based on 2019 OICA data) from the European Union are Germany, France, and Spain. The development trajectory of these countries in the field of electromobility is presented using descriptive statistics. Sustainable development goals can be achieved by creating an innovative environment and overcoming barriers to innovation, which can be indicated, for example, by the number of patents in a given country. Therefore, a long-term time series based on patents related to electric vehicles will be explored using the database of the European Patent Office. The study describes the vehicle manufacturers with the most patents, and the main patent areas in the three countries analysed.

Keywords: electric vehicle, Germany, France, Spain, patent analysis.

1. Introduction

This study focuses on the European vehicle manufacturers with the most patents in select countries, and their main patents that have relevance in the development of electric vehicles. As part of this study, we analyse the electric car market in Germany, France and, Spain, as well as relevant information about these three countries and their automotive market. These countries were selected since they are the main car manufacturers in the European Union, based on the database of the International Organization of Motor Vehicle Manufacturers (OICA) in 2019 (OICA 2019). We also summarize the tendencies and the factors that influence the proliferation of electric cars. Finally, we analyse the patent applications of the given countries as an indicator of the progress and the commitment of car manufacturers towards electric vehicles.

2. Background information

This section introduces the main strategy of the European Union to address climate change. That action could influence the decision-makers all over the EU including Germany, France, and Spain. The second part of this section describes the main characteristics of the electric car market in the countries analysed.

2.1. European Green Deal

Climate change and environmental degradation are a real threat to Europe and the world. To meet these challenges, the European Union has developed a new growth strategy that will transform it into a modern, resource-efficient, environmentally friendly, and competitive economy. The goal is to have zero greenhouse gas emissions in the EU by all industrial production processes, as well as vehicles involved in all forms of transportation, by 2050.

The European Green Offer is a plan to make the European Union economy based on a sustainable business model with a focus on zero CO_2 emissions (see Figure 1). The way to bring about these changes is to solve climate and environmental challenges and to make the transition fair and economically accessible to consumers. The operational benefit of the European Green Deal is to promote resource efficiency through the transition to a clean, circular economy and the restoration of biodiversity, and the reduction of pollution and waste, throughout the entire life-cycle of products. The plan outlines the investments required to achieve a successful transition as well as the available funding instruments. It explains how to ensure realism and an all-encompassing transition phase. The European Union aims to be climate-neutral by 2050.

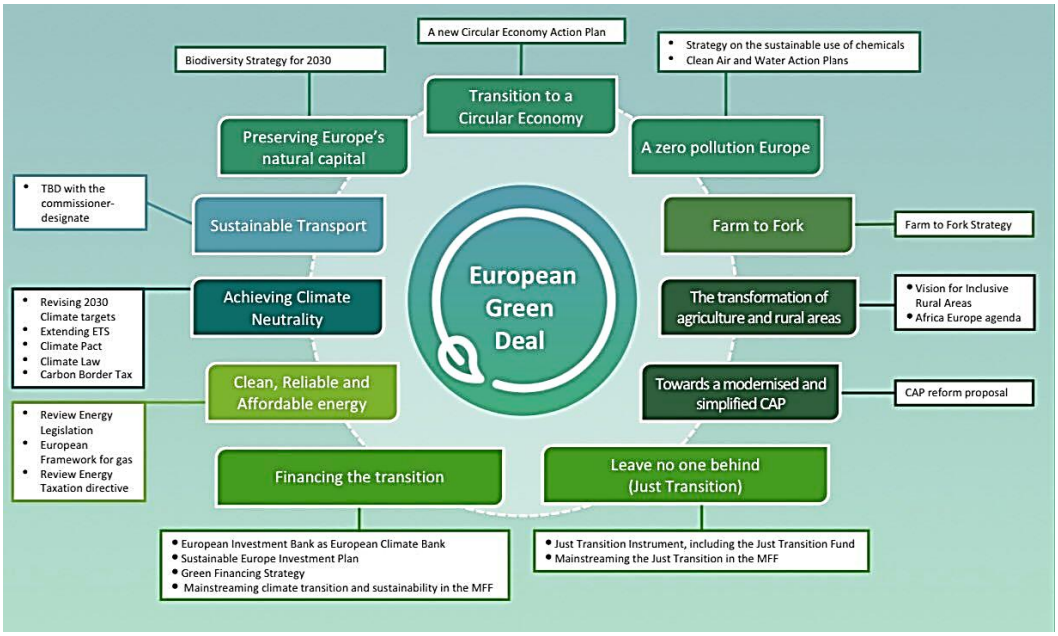
To achieve this goal, there is a need for all sectors of the European Union economy, including the development and introduction of environmentally friendly technologies, support for industrial innovation, and the introduction of private and public transport in cleaner, cheaper and healthier forms, to decarbonize the energy sector. The European Union provides financial support and technical assistance to help those affected by the transition to a green economy (European Commission 2021).

However, all electric vehicle patents may not be supportive of the sustainability portion of the EU Green New Deal, since the entire life-cycle of electric vehicles and their components must be taken into consideration. For example, advances in battery technology may not necessarily address the issue of how to recycle dead batteries with minimal impact on the environment.

The European Commission has 10 key areas for action and 82 start-up decisions to make the vision a reality. The sustainability of transport depends on increasing the number of zero-emission vehicles, ships and aircraft, renewable and low-carbon fuels, and related infrastructure. To this end, the goal is to install 3 million public electric charging stations by 2030 (European Commission 2020).

Electric vehicles are important to European industry for many reasons. They will bring new market opportunities and new jobs. At the same time, they would provide better energy efficiency and reduce greenhouse gas emissions. The development of an electric vehicle industry requires considerable investments in research, technology, and development support for the reaction of new markets and new business models but also changes in the mobility behaviour of both individual people and the society as a whole (European Parliament 2010).

Figure 1 European Green Deal Goals



Source: European Commission (2019)

In addition, the advancement of electric cars could have a major impact on the already transforming automotive industry. An example is Tesla, which uses non-traditional sales and marketing methods (see Thomas–Maine 2019, Falát–Holubcík 2017). At the same time, the automotive industry is a significant player in terms of economies, as it is a major exporter, contributor to GDP, and employer. Thus, the welfare of the analysed countries can be strongly influenced by the competitiveness of the automotive industry. An additional statistical argument also supports the analysis of the automotive industry, as there could be a correlation between living standards and the number of cars (Fleischer 2011, Szalavetz 2013). On the other hand, vehicles, like passenger cars, have increased individual mobility, thus giving people more freedom, and reshaping environmental and social attitudes.

2.1. The electric car market in Germany, France, and Spain

Our study summarizes the main information about the German, French and Spanish car markets. Based on the database of the International Organization of Motor Vehicle Manufacturers (OICA), passenger car production decreased in Germany, France, and Spain in 2020 compared to the previous year. One of the reasons was the spread of Covid-19, which caused a considerable challenge for the automotive manufacturers. The average pandemic-related shut down duration was 30 working days in Germany, and 34 working days in France and Spain during March, April, and May 2020 (ACEA 2020a).

The estimated loss in production was the highest in Germany within the European Union (616,591 vehicles). It affected 568,518 employees there (ACEA

2020a). Compared to the number of employees in the German automobile industry in 2020, the effects of the pandemic could influence about 70% of the employment (calculated based on the Statista.com database). It is possible that its total effects could be higher because the number of employees in the industry decreased by about 3% in Germany (Statista 2021).

It is an interesting fact that electric car manufacturing in Germany was able to continue its growth trajectory despite Covid-19. It achieved increasingly higher proportion rates within the German production between 2019 and 2020, based on the dataset of Verband der Automobilindustrie (VDA 2021).

The number of total car sales in 2020 also declined in each country that was analysed, as shown in Table 1. The most significant decline was in Spain in 2020. This is not surprising since the Spanish real GDP per capita value also decreased by the largest percent among the three countries. Car sales are sensitive to effects on the economy. If a recession or depression were to occur in the economy, the car sales could drop dramatically as they did during the 2008 financial crisis (for more information, see Grigolon et al. 2016, Sass and Szalavetz 2013, ACEA 2010, and Haugh 2010). Based on the research of the Deloitte Insights, a significant proportion of the Spanish (56%), French (51%) and the German (40%) consumers said that they intend to keep their current vehicle longer than they originally planned (Deloitte Insights 2020) because of the uncertainty caused by Covid-19. This could result in causing a similar drop in car sales as was experienced in 2008.

Table 1 Main indicators of the German, French and Spanish automotive industry

2020 (*change compared to the previous year*)	**GERMANY**	**FRANCE**	**SPAIN**
Passenger car production	3,515,372 cars *(–24.6%)*	927,718 cars *(–44.6%)*	1,800,664 cars *(–19.9%)*
Passenger car sales	2,917,678 cars *(–19.1%)*	1,650,126 cars *(–25.5%)*	851,213 cars *(–32.3%)*
Passenger cars in use (2019)	47,715,977 cars *(+1.3%)*	32,416,180 cars *(+1.2%)*	24,558,126 cars *(+2.0%)*
Passenger cars per 1,000 inhabitants (2019)	574 cars *(+1.2%)*	482 cars *(+0.8%)*	519 cars *(+1.2%)*
Real GDP per capita	34,110 euro (–4.9%)	30,480 euro (–8.4%)	22,350 euro *(–11.3%)*

Source: Self-created table based on Eurostat (2021a), (2021b), and (2021c); OICA (2021a) and (2021b) datasets.

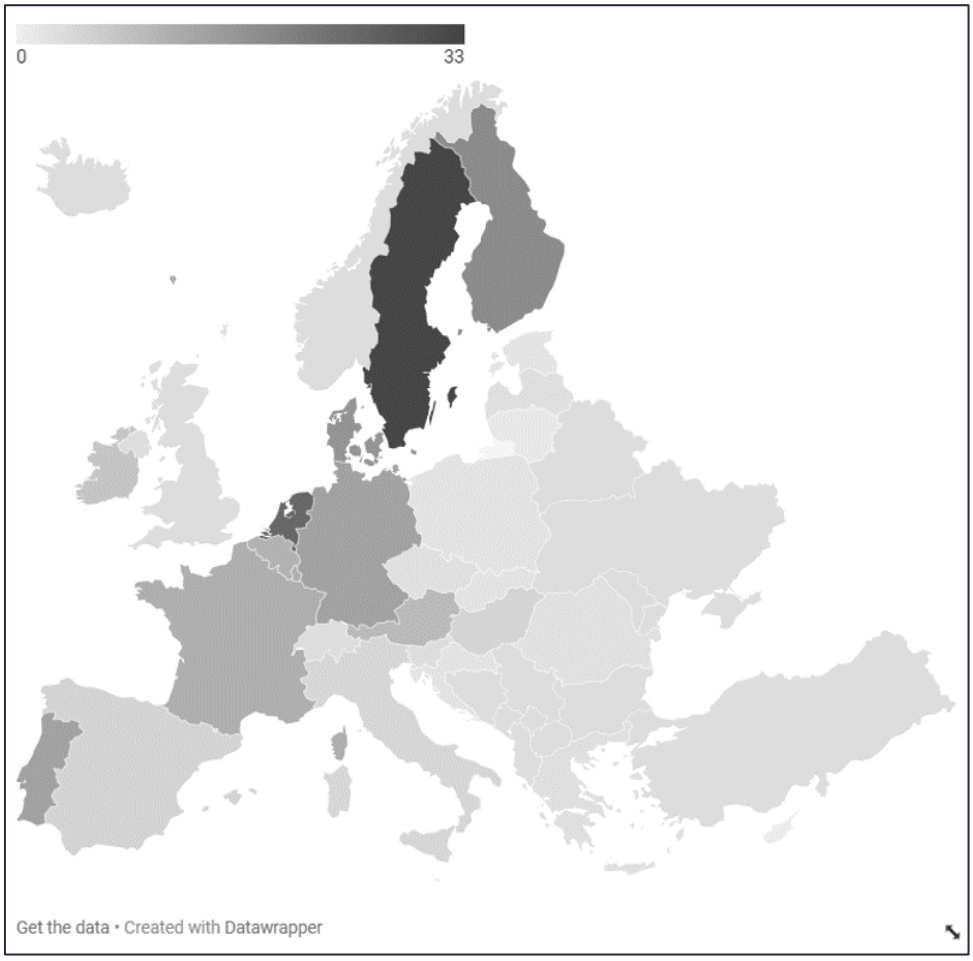
Table 1 also includes figures on the passenger cars in use and the passenger cars per 1,000 inhabitants, because the market size also could affect the proliferation of electric cars. Both data came from 2019, therefore, they were not influenced by the Covid-19 pandemic. The indicator relative to population may give a more reliable picture, as it also considers the population of the given country.

But both indicators showed small increases in the three countries. This could be a positive effect because it means a potentially significant market for electric cars, and it could benefit the well-being of the inhabitants. On the other hand, it was a negative consequence, because there are more cars on the road which produce more air and noise

pollution and emissions. From Table 1 it could be assumed that the proportion of electric cars of new car registrations is the highest in Germany.

After a general picture of the car industry in Germany, France, and Spain, the study visualises the main tendencies of the electric car market within the countries analysed. Figure 2 illustrates the proportion of electric cars within all new car registrations in the European Union in 2020. Based on the figure we could assume a strong connection between the GDP per capita and the penetration of electric cars. Among the three countries analysed, Germany (13.5%) had the highest proportion, France came next (11.3%), and finally Spain (4.84%) in 2020.

Figure 2 The proportion of electric cars within new car registrations in EU-27 (%), 2020



Source: Self-created figure with Datawrapper based on the ACEA (2021) dataset

The order shown in Figure 2 can also be observed in the growth rate compared to the previous year. The number of electric cars rose by nearly 263 percent in Germany, 202 percent in France, and 136 percent in Spain in 2020, as calculated based on the ACEA

dataset (ACEA 2021). That trend was mainly due to government subsidies (for example, tax benefits and purchase incentives of electric vehicles).

Despite the high growth rates, the numbers showed that the proportion of electric cars was quite low in 2020, especially since the figures include two categories: battery electric vehicles (BEV), and plug-in hybrid electric vehicles (PHEV). The operation of the BEV could be locally neutral to the environment (Milev et al. 2021, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety 2019, Gopal et al. 2018) because it does not contain an internal combustion engine, fuel tank, or exhaust pipe. Therefore, an ever-increasing number of governments support the purchase of these vehicles.

On the other hand, the production of electric cars, charging materials (if the electric car owners charge it with electricity generated by a thermal power plant) or the mining of its raw materials could also increase the emissions and environmental pollution. Consequently, the sector needs significant developments to become environmentally friendly in the future (Nanaki 2021, Hussain et al. 2020, Kasti 2017). Those innovations could cause some spill-over effects to other sectors, such as in the production of laptop computers or mobile phones (Mester 2019).

In the second type of electric vehicle (PHEV), there are internal combustion engines as well as electric motors. Hence, it could use only its battery power. However, the advantages of internal combustion (like the short charging time) also characterize it, so there is no need to change the daily routines of the owners. As Table 2 shows, most buyers preferred the cars from the PHEV category in 2020 in the countries analysed: their growth rates were higher in the three member countries, and its new car registration compared to the previous year was also greater than that of the battery-electric cars in Germany and Spain.

Table 2 Comparison of new Battery Electric Cars, Plug-in Hybrid Cars and Hybrid car sales in Germany, France, and Spain in 2020

2020 ***(change compared to 2019)***	**GERMANY**	**FRANCE**	**SPAIN**
Battery Electric Cars	194,474 cars *(206.3%)*	111,127 cars *(159.48%)*	17,927 cars *(78.52%)*
Plug-in Hybrid Cars	200,469 cars *(342.07%)*	74,592 cars *(301.20%)*	23,306 cars *(213.59%)*
Hybrid cars	327,395 cars *(68.85%)*	168,873 cars *(58.15%)*	137,425 cars *(26.45%)*

Source: Self-created table based on the (ACEA 2021) dataset

Table 2 also highlights the leading role of hybrid passenger cars (HEV), but these do not fall into the category of electric cars. The HEV category includes vehicles that are powered by internal combustion engines (ICE) but have one or more electric motors. The electric motor provides extra power, therefore the size of ICE could be smaller than the traditional versions (without an electric motor). The main difference between the HEV and the PHEV is that the HEV could not be charged by off-board sources. It uses regenerative braking and an internal combustion engine to capture energy. In contrast, a PHEV could be plugged into off-board sources of electricity to charge its battery.

Strong support by the government was an important factor in the demand for electric passenger cars in 2020. This connection is a rapidly expanding research topic in the literature (O'Neill et al. 2019, Liao et al. 2017). But its effects cannot be determined conclusively. For instance, some studies found that the tax reduction could be an effective action to influence the proliferation of electric cars (O'Neill et al. 2019, Glerum et al. 2014, Hess et al. 2012), however, there are some other factors as well (Endo et al. 2016, Hess et al. 2012, Zhang et al. 2011). Therefore, the financial incentives could be an essential component because of the inherently high price of electric cars, but its effectiveness may be significant only above a minimal cost threshold (Sierzchula et al. 2014, Jenn et al. 2013).

For example, in Norway, the owners of electric cars gained various benefits in 2020, such as tax exemption of green cars (for example no weight tax, CO_2 tax, or VAT), or lower parking fees (Norskelbilforening 2021). Because of the various state actions, 54 percent of new car sales were purely electric in Norway in contrast with 8 percent of petrol-only and 9 percent of diesel-only in 2020 (Klesty 2021). The Norwegian decision-makers have been motivated to encourage the purchase of electric cars since the 1990s. However, the data show that the penetration of electric cars was a slow process. Moreover, Norway has high GDP per capita based partly on its oil and gas exports, therefore they are better able to apply for such subsidies and investments than less wealthy countries (Heymann 2020). On the other hand, electric cars could be climate-friendly in Norway because their main source of electricity is hydropower (Heymann 2020). This fact also could increase the demand for those cars in Norway.

Similar motives are present in Germany, France, and Spain as well. Table 3 sums up the tax benefits and the purchase incentives of electric cars. In our study, we highlight the second option because the tax benefits are not the best alternative to motivate the demand for electric vehicles, as stated in the literature (for example Yan 2018).

Table 3 Tax benefits and purchase incentives for the electric vehicles in the countries analysed in 2020

2020	**GERMANY**	**FRANCE**	**SPAIN**
Tax benefits of electric vehicle (purchase, owners)	Temporary VAT reduction from 19% to 16% (between 1 July 2020 and 31 December 2020). 10-year exemption for BEVs and FCEVs registered until the end of 2020.	Regions provide an exemption for alternatively-powered vehicles. -	Exemption from 'special tax' for vehicles emitting up to 120g CO_2/km, and VAT exemption for alternative-powered vehicles in the Canary Islands. 75% reduction for BEVs in main cities.
Purchase incentives of electric vehicles	Environmental and innovation bonus	Bonus to purchase car or van with ≤20g CO_2/km. Scrappage scheme.	Incentive scheme

Source: Self-created table based on the (ACEA 2020b) dataset

In contrast to the Hungarian support system, the three countries analysed promote the buying of BEVs and PHEVs. Not surprisingly, Germany has the highest government assistance for the purchase of electric vehicles. There was no price limit, but two price categories existed in 2020. The customers who buy vehicles with an equal or lower net list price than €40,000 in Germany can gain a €9,000 bonus if they choose a BEV or FCEV[5], or a €6,750 bonus for a PHEV. If the car's net list price is more than €40,000, the state aid promised a €7,500 bonus for BEVs, FCEVs, and €5,625 for PHEVs in 2020 (ACEA 2020b).

For example, the price of the Volkswagen ID.3 reduced to €23,430 because of the bonus by the government. It means that its price became lower than the e-Golf (Mk7 Golf platform), or the new ICE-powered Mk8 Golf (Ramsey 2020, VolkswagenAG 2020). Finally, in 2020 the Volkswagen ID.3 was the 4th bestselling electric car in Germany, even though it was launched in the summer of 2020 (Best-selling-cars.com 2020a). That case showed how government policy can influence the demand for electric vehicles.

Financial support is high in Germany, and it is not random. The aim of the German Climate Action Programme 2030 is to reduce transport-related emissions by 40-42 percent by 2030. It means that more electric cars need to be out on the roads. The government planned that there will be 7-10 million electric vehicles registered in Germany by 2030. Therefore, the number of charging stations will be 1 million in 2030 (Bundesregierung 2019).

The French decision makers also determined the price limits. However, in the purchase incentives, they did not regulate the type of electric or alternatively-powered vehicles. The support was there for the purchase of cars or vans which have a lower emission than 20g CO_2/km. If the price of the car was lower than €45,000, then the households could get €7,000 and the legal persons gain €5,000 in 2020. If the vehicle price was between €45,000 and €60,000, the aid for the legal persons was €3,000 for the households. In the case of the FCEV, if the price of the car or van is higher than €60,000, then the household or the legal persons could receive also €3,000.

In France, there was a scrappage scheme for the purchase of second-hand or new vehicles with ≤50g CO2/km, if the price was lower than €60,000. The household's support was €5,000, and a legal person could get €2,500 in the case of the purchase of a car. The state aid was €5,000 for households or legal persons as well if they bought a van with the given details (ACEA 2020b).

To motivate the demand for electric vehicles more, the French policymakers signed the Objectif 100,000 Bornes Charter in 2020. The goal of that document is to build 100,000 public charging stations with a budget of €100 million much faster than previously scheduled, by the end of 2021 instead of 2022 (Union Francaise de l'Électricité 2021).

In Spain, there were no price limits in 2020. The incentive scheme supported the private purchases of BEVs with €4,000 – €5,000. It was almost half of German bonus. Purchase of PHEVs was rewarded with €1,900 – €2,600. In the case of the vans

[5] It is the acronym of fuel cell electric vehicles, which are powered by hydrogen. That type of vehicle also does not produce tailpipe emission.

and trucks, the aid is between €4,400 and €6,000 for private individuals, depending on scrapping (ACEA 2020b). The penetration of electric cars is lower in Spain compared to France or Germany, and the main fleet of that type of vehicle could be found in Madrid and Barcelona.

The financial incentives were not the only factors that could influence the demand for electric cars. The literature indicated other factors as well, such as the acceptance of that vehicle type by individuals and companies (Wallis–Lane 2013), the infrastructure investments (Sierzchula et al. 2014, Brand 2016), or social norms (Barth et al. 2016). The up-to-date information could also affect the decision of the consumers.

For example, an American study analysed the lack of knowledge with a questionnaire that was filled out by 502 people. The conclusion was that the consumer did not have enough information about the technical details of the electric cars, their maintenance costs, the availability of mechanics and services, their amortisation, or the network of the charging points. However, if a consumer had any prior experience with the electric car, then there was a higher probability that he/she would have chosen it (MacInnis 2020). It shows that car dealers and governments need to inform the potential buyers about the electric car because they could enhance the demand for them this way.

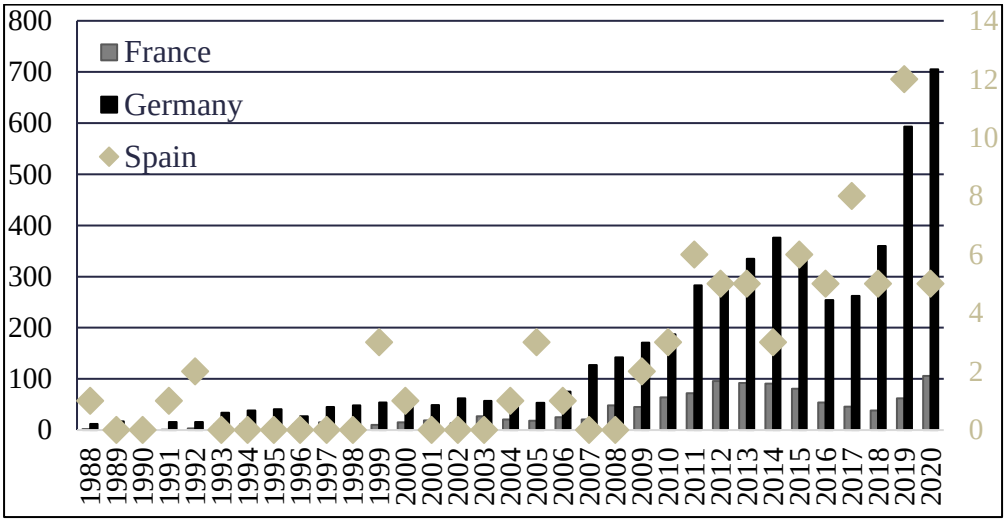
3. Patent overview of the electric car production in Germany, France, and Spain

Since the aim of the electric vehicle is to be climate-friendly, then the automotive industry and the related industries (like the energy sector) need various developments and innovations. Consumers prefer long battery life, low prices, quick charging times, and good charging infrastructure (Heymann 2020). Therefore, this study examined the patents that are linked to electric vehicles to see the innovations in the counties analysed.

More publications analysed the connection between patent and technology development, innovation, or R&D (for example, Baumann et al. 2021, Han et al. 2021, Lai et al. 2021, Lee et al. 2021, Ma–Porter 2015, Ma et al. 2014, Teichert–Ernst 1999). Our study built on an article that also analysed the patent of the electric car based on the "Electric propulsion with power supplied within the vehicle" category of the Espacenet (Pilkington et al. 2002). Its main consequence was that the significant patent-owning companies in the USA were Toyota, General Electric, and Mitsubishi.

To analyse the number of patents linked to electric cars, the Espacenet patent search database was used. Based on that database the users could search within the European Patent Office (EPO) information. In the advanced research, the "electric propulsion with power supplied within the vehicle" category was chosen (B60L50). We analysed the patent family instead of the publications. The webpage of the EPO defines it in the following way: "Set of interrelated patent applications filed in one or more countries to protect the same or a similar invention by a common inventor and linked by a common priority" (EPO 2021). The results included the classification of the International Patent Classification (IPC) and the Cooperative Patent Classification (CPC) where the publication date of the family is between 01.01.1988 and 31.12.2020. One of the limits of this method was that the patent of electric cars could not be distinguished from the other electric vehicles, such as golf carts, electric bicycles, etc.

Figure 3 Patent numbers of the B60L50 category in France, Germany, and Spain between 1988 and 2020



Source: Self-created figure based on the (Espacenet 2021) dataset

Figure 3 presents the patent numbers of the "Electric propulsion with power supplied within the vehicle" category (Espacenet 2021). The left axis (black) shows the values of France and Germany, while the right axis (light gray) shows the values for Spain. As the previous section has shown, Germany is the leading automotive producer in Europe, consequently, this country owned the most patents in the integration. Based on the analysed patent category, Germany competed with Japan, the USA, and Korea. In 2020 Germany had the most B60L50 patent number globally. This fact shows how strong the German automotive industry focuses on the electric vehicle segment.

The period of the given German patents could be divided into two phases. The first phase was between 1988 and 2006 when its values were low. At that time the main focus of the industry was on vehicles with internal combustion and diesel engine, because their production was more effective and lower cost.

The second phase started in 2006 and ended in 2020, and it presented a dynamic growth in the patent numbers (except 2015 and 2016). One of its reasons could be that the German government supported the development of the electric car. The "Nationale Strategiekonferenz Elektromobilität" was announced at the end of 2008. It aimed to reach 1 million electric vehicles on the German roads by 2020. Next year a €500 million programme was started within the national Economic Stimulus Package II to accelerate the development and deployment of electric vehicles. That action mainly focused on technology and research.

The German government also founded the lithium-ion battery research programme (LIB 2015) with €60 million between 2008 and 2015 (European Parliament 2010). In 2010 the National Platform Electric Mobility (NPE) was announced, which brings together the main actors, that is, the manufacturers, the suppliers, politics, academia, the associations, unions, and society. Seven working groups were established to support the National Development Plan for Electric Mobility (European Parliament

2010). Therefore, the German automotive industry was characterized by a high level of interconnection, which could result in competitive advantages.

The German automotive industry concentrated on the development of electric vehicles, because if it could not keep up with its competitors like the USA, Japan, or China, then it could lose its lucrative positions on the market. As mentioned in the previous section, government incentives also played an important factor in the demand for electric vehicles, and more purchases were favourable for the manufacturers as well. The German studies also highlight the main role of the state subsidies (for example, in Scharf 2020, Klößner–Pfeifer 2015, Böckers et al. 2012, Höpfner et al. 2009).

The patent numbers analysed in France showed a tendency for a slow increase. The French government, like its German counterpart, also promoted the production of electric cars. For example, €400 million for R&D was announced on low-carbon vehicles between 2008 and 2012. That programme supported the development of vehicles as well as the infrastructure for charging. From 2009 a specific working group dealt with the installation of a charging network (European Parliament 2010). Because of Covid-19, the French President Emmanuel Macron has announced an €8 billion aid package to support the car industry. One of its aims is to make France a leading electric car manufacturer (RFI 2020).

The given patent numbers also followed an increasing tendency in Spain, however, the values were very low in comparison to France and Germany. The Spanish government announced various programs like MOVELE, and made more investments, but generally, those actions focused on the charging points and the purchase of electric cars (European Parliament 2010). The goal of the Integrated National Energy and Climate Plan 2021–2030 following the European Union's (EU's) energy and climate targets for 2030 is to achieve a fleet of 5 million electric vehicles on the Spanish roads with 500,000 chargers in 2030 (Congreso de Los Diputados 2019).

A common feature in the three countries analysed is the same main CPC subgroups, which were the following categories:

- Energy storage systems for electromobility, e.g. batteries (Y02T10/70);
- Electromobility specific charging systems or methods for batteries, ultra-capacitors, super capacitors or double-layer capacitors (Y02T10/7072);
- Electric energy management in electromobility (Y02T10/72);
- Energy storage using batteries (Y02E60/10);
- Electric machine technologies in electromobility (Y02T10/64).

Those developing areas are in line with consumer preferences. Based on the international survey by Deloitte (2021), German customers usually are concerned about the driving range (28%). The time required to charge (13%) was also highlighted after the lack of charging infrastructure (22%) and the cost/price premium (16%). The new technological improvements could also be good for the manufacturers because they could reduce their production costs.

Based on the database, the main applicants could be also collected from Germany, France, and Spain. As expected, most patents are tied to major European car manufacturers and their main suppliers. The competition between manufacturers and suppliers could stimulate development and productivity.

The Volkswagen Group had the most patent applications in Germany until 2020. It included Audi, and Porsche manufacturers as well. It is one of the main electric vehicle producers in 2020 (Auto-motor-und-sport.de 2020). Herbert Diess, the CEO of the Volkswagen Group announced that the company focused on electromobility with €30 billion in E-Offensive. Consequently, the group plans to launch more than 50 new electric vehicles by 2025, and every fourth car in the Group will be clean electric (VolkswagenAG 2021). On the other hand, the giga-factory of Tesla in Berlin is scheduled to start its production in early 2022. This announcement put great pressure on German manufacturers and further motivates them to make improvements.

Bosch was the main patent owner from the supplier category in Germany. The enterprise prepared for electromobility, because it assumed rapid growth in the years ahead (Bosch 2018). The data confirmed that assumption. Almost 40 percent of the sales revenue came from the electrical powertrain components in 2020 (Bosch 2021a). The company has built a great amount of capacity for power electronics, solid-state cells, and battery management (Bosch 2021b).

To see the reaction of the automotive suppliers to electro mobility in Germany Strina and Schmidt (2019) analyse 6 firms in South Westphalia. Their results show that the impact of electromobility is so far relatively low in the market. However, if the growth of e-vehicles continues to accelerate, the sales of companies in the exhaust / engine / transmission sector will decrease. An interesting consequence is that those companies that will be little affected by electromobility are already preparing for the change, mainly seeing opportunities in it, and already delivering for electric cars. But those suppliers that will be more affected by electromobility, tend to believe less that electric cars will prevail in the next 10 to 20 years, and try to optimize existing products for the combustion vehicle (Strina and Schmidt 2019).

In France, the most patent application is linked to the Renault Group. This is not surprising because the leading passenger electric vehicle model by fleet size in the European Union was the Renault Zoe, and was ahead of the Tesla Model 3 in 2020 based on the dataset of Statista (2021b). Most electric car buyers in France, Spain, and Germany too chose the Renault Zoe in 2020 (Best-selling-cars.com 2020b). In the "Renaulution" Strategy, the Renault Group (Renault, Dacia, Alpine and Mobilize) planned to launch 7 electric vehicles from the 14 new models by 2025 (Renaultgroup 2021).

Valeo was the supplier who had the most patent in France in the period analysed. The data has shown that the firm is innovative and tries to find new solutions. For example, in the Valeo catalogue in 2020, there were more than 13,000 new products and almost 60% of orders were for innovative products. Innovation means high investments, so Valeo spends more than €10 billion in technologies to reduce CO2 emissions (Valeo 2021).

In the case of Spain, the number of patents is really low. One of the reasons for this could be that even though Spain is a major vehicle manufacturer, its factories are owned by foreign investors. The main applicants were Charles Rippert and Franz Rueegg based on the dataset of Epsacenet. They have 4 patents each.

An interesting fact is that the list of the 50 biggest R&D inventors among companies in 2020 had significant representation from the automotive industry. Volkswagen was in 3rd place, Daimler 10th, but Toyota (12th), Ford (14th), BMW (17th), Bosch (19th), Nissan (37th), Renault (48th), and Peugeot (50th) also were on the

list (Petrov 2021). However, if we consider the most innovative companies in 2020, then we could also find the same companies, but their rankings are not as high there. For example, Volkswagen ranks 32nd in the most innovative companies. It improved six rankings over the previous year. Bosch as a new entrant was the 33rd (Colombus 2020). Therefore, those companies could move forward, however, they could not gain on Tesla, which was in 11th place (Colombus 2020).

4. Conclusion

The focus of this study has been to survey the patents in Germany, Spain, and France that have potential applications in the development of electric vehicles. The dataset showed an increase in new electric car registrations, although its proportion within all cars on the road is still rather low. The dynamic rise in demand was affected positively by the financial incentives of the governments. In addition to subsidies, other actions and tools will be needed to accelerate the spread of electric vehicles, because currently, their price is high in comparison to conventional cars. Furthermore, the potential owners do not have enough information about the financial benefits such as government subsidies and about technical details such as charging times and already available charging stations.

To reach a higher market penetration and climate-friendly characteristics, the electric car industry has to improve and innovate. The patent numbers have also been analysed in the three countries within the B60L50 category based on the dataset of the European Patent Office. The results have shown a dynamic growth in the patent numbers between 1988 and 2020. The purchase and production of electric cars were subsidized by the Spanish, German and French governments, as part of their climate strategy, which is part of "The European Green Deal", since the European Union is committed to reducing CO_2 emissions through increasing electric transportation.

Generally, most patent applications originated from the main automotive manufacturers within the countries analysed. The manufacturers are motivated to develop their electric vehicle technology, because of the regulations (e.g. CO_2 quotas), as well as the higher demand inspired by the financial incentives of the governments. Nevertheless, the competition and the leading position is also a powerful motivator because their main competitor, Tesla, is currently ranked higher in innovation. The American company not only uses new technologies but also applies other management and marketing tools.

Further research areas could be the analysis of the electric car market with a global, or a European Union perspective. In addition, the strategies of the electric car makers and their main suppliers also could be examined. On the other hand, the consumer attitude could be analysed with questionnaires to see the acceptance of electric cars or the main influencing factors of the demand. To repeat the questionnaire survey also could be a research direction, because that shows how the attitude of the people changes during a given period.

5. Future Work

Based on the patent information that has been presented in this study, a deeper analysis could be carried out that would highlight the main directions of each of the research areas presented in the patent survey within this study, in order to show its relevance towards the development of electric vehicles.

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Beyond the questionnaires: An attempt to understand self-driving car acceptance by women through using movies and VR simulation

Brigitta Gábor – Miklós Lukovics

Among the technological novelties of the digital revolution, the self-driving car is considered to be a radical innovation stand-out which will revolutionize the habits of people living in civilization. The technological development of these cars is in its last stages, but the preparedness of consumers is lagging behind. General impression is not uniform by gender: women in developed nations tend to be unenthusiastic about self-driving cars, which could threaten their entrance on the market. Furthermore, in mainstream research (TAM, UTAUT), attitude towards the technology has been measured by questionnaire and less than 10% of respondents can respond based on real experience.

The aim of our research is, on the one hand, to explore methods by which subjects express their attitudes towards self-driving cars based on their own experiences, and, on the other hand, to examine the impact of their own experiences on the opinions of rejecting groups.

Keywords: radical innovation, self-driving car, netnography, VR simulation

1. Introduction

The car plays a key role in mobility today: according to a Eurostat survey, 83% the nature of all passenger kilometres travelled by car in the European Union have not changed significantly in the last decade (Eurostat 2019). It can be stated that the lives of all people living in so-called civilized countries are determined by cars: both when traveling by car and as other actors in transport (on foot, by bicycle, using public transport) coming into contact with them.

One of the radical innovation breakthroughs of the Fourth Industrial Revolution is the self-driving car (EC 2019), which will fundamentally change the lives of all of us because of the above. Radial innovations typically lead to a paradigm shift, usually inducing a radical change in both organizational structures and the market environment, sometimes in everyday life.

The technological development of self-driving cars is very advanced, however, research on the social acceptance of self-driving cars has found there is low social preparedness and acceptance. This could be a problem, because the acceptance or rejection of innovations, as well as their spread, is based on people's judgments and decisions. The success of the proliferation of self-driving cars depends not only on the development of technology, but also on legislation, infrastructure, and social acceptance (KPMG 2018).

In addition to the low level of social acceptance, its heterogeneity can be a significant problem, despite the fact that there is very little talk of the latter in the international literature: certain well-identified social groups (women, those with lower education, the elderly, people living in rural areas, etc.) could slow down or even jeopardize the market penetration of self-driving technology.

Havlíčková and co-authors (2019) shed light on the paradox that self-driving cars are most often rejected by those who could benefit the most from their use. Among the more dismissive social groups, women stand out, their share among drivers is growing year by year and has already exceeded 50% in the USA (Sivak 2013). If we add to these statistics the fact that surveys show women are otherwise much more likely to prefer public transport to the car (OECD 2019), it is easy to see that women are a distinct target market for a self-driving car that mixes the two solutions.

Based on all this, the aim of our research is to study the typical patterns of Hungarian women's opinions about self-driving cars with innovative research methods and, based on these, to make suggestions for shaping women's attitudes towards self-driving cars. Our research fills a gap in two respects: on the one hand, the vast majority of the surveys focus on developed countries, and on the other hand, they do not focus on women, so our survey and the recommendations based on it may serve as valuable input for scientific and practical professionals.

2. Self-driving cars

Self-driving cars should not be a radical innovation simply because the steering wheel disappears from our cars - that would not yet radically revolutionize the everyday life of humanity (EC 2019). However, self-driving cars, organized into a system, open up new perspectives on mobility, the consequences of which will affect almost every area of our lives: new travel habits, new business models, new networks, new cityscapes, new daily routines, and so on (KPMG 2018, Duarte–Ratti 2018, Audi-Ipsos 2019, Lukovics et al. 2018).

Organized into a system, self-driving cars open up a new perspective on urban mobility: MaaS, (Mobility as a Service). To put it very simply, the point is that we will not be driving our own cars in the future, but fleets of self-driving cars will help us reach our destination (Utriainen 2018). The car-sharing model envisages fewer traffic jams, faster traffic, less environmental impact, fewer accidents, and a changing cityscape: in this system, parking spaces will be freed up, and a park, playground and community space could be created instead (Duarte– Ratti 2018). Some say the new model will be much cheaper than maintaining your own car (WEF-BCG 2018), so the space use of garages might also be rethought. The system involves a complete transformation of our daily routines and decades of habits.

Technological developments related to self-driving cars have accelerated greatly recently: street self-driving tests are currently taking place in nearly 150 cities around the world, doubling the number of last year. That is, it appears that more and more developers are in the final stages of technological development, just before market introduction. Self-driving cars are not yet finished and will be much delayed, writes The Verge[6] in its analysis, and then the author turns to the rise, fall, and merger of smaller and larger companies. Although technological developments in the field of self-driving cars are advancing rapidly at an international level, significant issues remain regarding

[6] https://www.theverge.com/22423489/autonomous-vehicle-consolidation-acquisition-lyft-uber (Accessed: August 10, 2021)

mobility services related to the development and integration of self-driving cars and technical specifications for vehicles and infrastructure, data use, safety and security, vehicle operation. obligations and responsibilities, ethics, social acceptance, and the coexistence of human-controlled and automated vehicles (EP 2018).

In our view, the problem is caused, on the one hand, by the fact that developers, with very few exceptions, focus exclusively on technological development, and, on the other hand, by the fact that the drastic change described above is much closer at hand than what could be realistically be prepared for at the societal level. It is therefore necessary to extend development work to the social sciences, thereby accelerating social adaptation for humanity to be able to process the projected drastic change.

3. The psychology of male and women's opinion

Influencing the attitudes of large numbers of rejection groups is in some cases not feasible with pooled strategies. This is usually true in cases where the neurological-psychological background of each group or segment differs significantly. As we have seen in previous chapters, women and men are present in approximately equal proportions among drivers, however, women are significantly more reluctant to drive self-driving cars. However, the attitudes of men and women cannot be shaped by the same interventions!

The anatomical differences between the male and female brains are well established. Men have larger brains, while women use a more compact and larger part of the brain than men (Kimura 2004). Because several significant differences were found in different areas of the brain as well as in the grey and white matter, this explains why the two do not generally behave or think differently (Storms 2019). This is even explained by hormonal differences and traces of evolution (Brizendine 2011).

Women are more influenced by their emotions; they experience both positive and negative emotions more strongly than men (Hohenberger et al. 2016). Related to this is a proven fact that they also make their simpler decisions driven by their emotions faster than their male counterparts (Gray 1992). The "female intuition" used in everyday vocabulary also refer to this: in small-scale issues, they make quick decisions based on their intuitions. Furthermore, in a decision-making situation, personal influences affecting human destinies are also considered, and the world is usually perceived more comprehensively and assessed through the nature of human relationships (Storms 2019). In contrast, men mostly neglect these aspects of decision making, feeling redundant.

Van den Bos et al. (2013) also found a difference in information processing between women and men in the decision-making situation. Women are usually slower and find it harder to reach a decision than men. Accompanied by several questions, with more information and considering several factors, they form an opinion on a larger issue (Brizendine 2011). In this case, the decision-making process is longer and more complicated, but the decision is usually more comprehensive and balanced than that of men.

Because of information gathering, decision-making is more time-consuming than that of men who seek logic in almost everything, think more rationally, and examine longer-term effects (Kaileigh–Darrell 2015). On the other hand, when making

an opinion or decision of a kind that does not raise questions or possibly doubts, it is considered. to be a smaller volume, and a clear and quick resolution on the part of women. Men initially reject additional information, focusing mostly on future opportunities and consequences, compared to women, who are heavily influenced by external information sources. Women process much more detailed, comprehensive information, pay more attention to social guidance, and are more interested in personal, human contexts, and moral considerations (Kaileigh–Darrell 2015). It is also important from the point of view of our topic that according to the research results of Slovic (1997), women are more inclined to judge risks more deeply and are more concerned about the issue of safety.

It follows that when it comes to smaller, general opinion-forming, that is, it does not raise questions or doubts, such as *"What do you think about the self-driving car?",* women express their views from simple messages based on their first intuitions. However, if they are already faced with a real and far-reaching decision, that is, they feel closer to it, such as *"If you had to decide now, what aspects would you consider to replace your car with a self-driving car?"*, they need more information and details to make that decision.

4. Women's opinion about self-driving car in developed countries

Plenty of international research has addressed the issue of technology acceptance in relation to the issue of self-driving cars, and these are usually the TAM and UTAUT models, and most of the results of the research have been obtained through a questionnaire (Schoettle–Sivak 2014, Kyriakidis et al. 2014, König–Neumayr 2017, Hulse et al. 2018, Liljamo et al. 2018, Havlíčková et al. 2019, Raue et al. 2019, Wang et al. 2020), but it masks freedom of opinion. It is important to point out that these surveys usually examine the opinions of civilized people in such a way that the majority of respondents have not even encountered a self-driving car at all, and presumably have only vague ideas about technology that may even form a misconception in people's minds.

To the best of our knowledge, women's attitudes have not yet been studied in the international literature, but data on women can be collected through the demographic delineation of the most significant empirical studies conducted in developed countries. Thus, several international studies have found that men attribute a more important role to self-driving technologies than women (Kyriakidis et al. 2014, Schoettle–Sivak 2014). In contrast, according to research by Frost & Sullivan (2014), after a few years, women will prefer high-tech vehicles, including self-driving vehicles.

In the international research of the research pair Schoettle and Sivak (2014) (American, English, and Australian), as well as data from Kyriakidis et al. (2014) and in terms of benefits, there were more men who thought they would benefit in the future. According to research by Kyriakidis et al. (2014), approximately a quarter (23%) of men, while slightly more than 10% of women, said they considered this innovation important. In this research, men would be willing to spend more on this innovation.

There are several differences in the attitudes of women and men, women are much more restless (Denise 2015, Nasr–Johnson 2016, AAA 2016, Smith–Anderson 2017, Lienert 2018). Women are less interested (Denise 2015, Raue et al. 2019) and have less information about self-driving cars (Smith–Anderson 2017). Twice as many

men think positively about self-driving cars than women (Liljamo et al. 2018). Most women question the safety of self-driving cars (Denise 2015, Nasr–Johnson 2016), while many men feel stressed by the disappearance of the driving experience. Men seem to be more interested in trying out cars, as well as owning and buying them (Denise 2015, Nasr–Johnson 2016, Smith–Anderson 2017). Based on the results of Lienert's (2018) research, the majority of American women would feel uncomfortable driving without a driver, while male respondents were less valued, and when examining other actions on the road, they found that women did not want to spend time with other activities and would rather keep their eyes on the road in the interest of safety (Nasr and Johnson 2016).

If we look at various studies in this area, such as the AAA (2016) research, we can see that the reason *"they feel the use of technology is too complicated"* was mentioned by twice as many women as men, which is why they don't want to use technology.

Based on the above, it can be concluded that women have less information and are more reluctant about self-driving cars. The results from developed countries show that women are more likely to question this technology than to accept it. Men are proving more accepting of driverless cars, although they still have doubts in some areas. Although the degree of mistrust and skepticism is still quite high, society is curious about the technology.

5. What do Hungarian women think about the self-driving cars?

We examined the attitudes of Hungarian women towards self-driving cars and their reasons with four layers of empirical surveys, expecting different answers from each type of survey:

- We expect netnographic research to explore and categorize the underlying attitudes.
- We expect answers from 496 completed questionnaires on how opinions about self-driving cars differ by gender, and how these change over time because of expanding information.
- We expect an answer from moving image emotion research to the reasons behind an attitude on how these change because of one's own specific experience, and what emotions these experiences evoke.
- With virtual reality simulation, our aim was to examine participants' reactions and feelings about self-driving cars and through these reactions to find out whether virtual reality experiments can help in the acceptance of self-driving cars or not.

5.1. Netnographic exploration

As our aim was to explore a pattern of underlying attitudes, a netnographic research was used. Put simply, netnography covers online ethnography, which analyzes Internet posts using scientific methods (Dörnyei–Mitev 2010 / b). In netnography, interactions on Internet interfaces are valued as cultural reflections that result in deep human understanding (Kozinets 2010). Emotional and confidential posts also become available through the possibility of anonymity (Puri 2009), which in the case of ethnographic research is extremely time-consuming (Csordás–Markos-Kujbus 2018). Of course, not

all online communities meet the requirements for netnographic fieldwork, which are as follows (Kozinets 2010):

- be relevant to the focus of the research,
- there should be active communication between the contributors,
- be interactive,
- critical mass prevails,
- have many different posts and make detailed, rich data available.

The HVG Tech and Car sections, the index.hu Tech section, the Origo Tech section and the Totalcar met the above-mentioned requirements the most. On the four platforms, we analyzed the writings related to self-driving cars and the related 1,050 comments related to one year back (January 1, 2019 to January 1, 2020). In many cases, the involvement of the readers was very intensive, contradictions and minor conversations were noticeable among the commenters, and it could be observed that some of them also included links and contents that appeared on other pages to support their claims.

It is very striking that female posts were much lower than male posts: only 7% of respondents were female. The contributors found on the Internet social interfaces can be organized into different groups and categories (Dörnyei–Mitev 2010/a).

Based on the comments, we identified six different groups, these categories are surrounded by a distinctive tone, and it can be concluded that these groups represent different values. The six main "in vivo" groups are as follows:

1. Rejection, critical (30.8%): several arguments are put forward to express their displeasure or even outrage and to endorse self-driving cars with a critical opinion. Their views change in some situations because of new information.
2. Eternal skeptics (19.2%): stand out among the rejecting, critical contributors. They are the ones who see only the downsides of self-driving cars and speak out completely against them. In most cases, there is no argument behind their opinion, in their case the reason for rejection is difficult to discover.
3. Optimistic (19.2%): The greatness and future potential of the technology was justified by positive reasons for listing the benefits. In many instances, those who showed completely different attitudes expressed their opinions based on each other's counterarguments. Hopeful opinion-formers were largely characterized by moderate affectivity.
4. Realists (38.5%): they see the existing obstacles as well as the potential opportunities.
5. Informants, experts (3.8%): they usually reflect the answers of rejectors and problem takers. They they try to support the critical opinions and the questions that may arise with their own, well-founded knowledge, even with external sources.
6. Problem raisers (7.7%): they ask further questions on the subject and on the future of transport, or in some cases feel that the article is incomplete or even consider that the information provided does not necessarily reflect reality. In some cases, they reflect on speakers who wish to be informed and address their questions to them.

66.7% of the women who spoke belonged to the negative, critical group, 20% to the group of realists, and 6.7% to 6.7% to the group of perpetual skeptics and informants. It is striking from the results obtained that there were no women who expressed only a positive opinion on the topic of self-driving cars, nor were there any problem raisers.

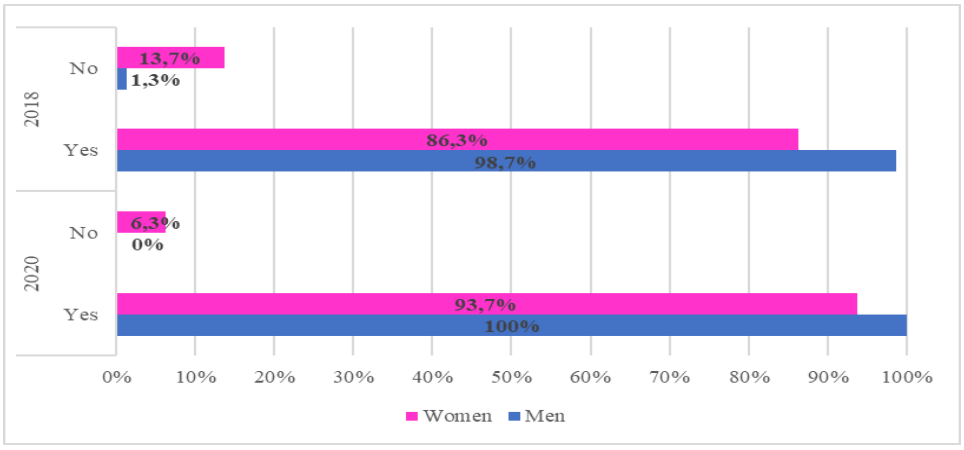
Netnography has shown that negative contributors tend to change their minds because of new information, and that their concerns relate to specific groups of topics: technological maturity, safety, accidents, liability, and so on. That is, it is all about a topic that would require much more information from contributors

5.2. Trend study 2018–2020

Year after year, more and more information about self-driving cars becomes available: scientific articles, blog articles, social media posts, etc., which also reach an increasing number of those who are less interested in the topic. Over time, the amount of active and passive information about self-driving cars is constantly increasing in society, which raises the question of how perceptions of self-driving cars change over time and with the amount of information.

At the beginning of 2018 and 2020, we interviewed a total of 496 respondents with an online questionnaire. Our sample is not representative. Among those who filled in the questionnaire, 44.9% of respondents were women. 84% of men and 58% of women felt that they had received new information about self-driving cars in the last two years. All this is clearly reflected in the change in general awareness: while in 2018, 13.7% of responding women had not heard of self-driving cars, in 2020 this figure dropped to 6.3%. Only 1.3% of men had not heard of self-driving cars in 2018, while by 2020, there were no more men who had not heard of the technology (Figure 1).

Figure 1 Awareness of self-driving cars by gender (%)

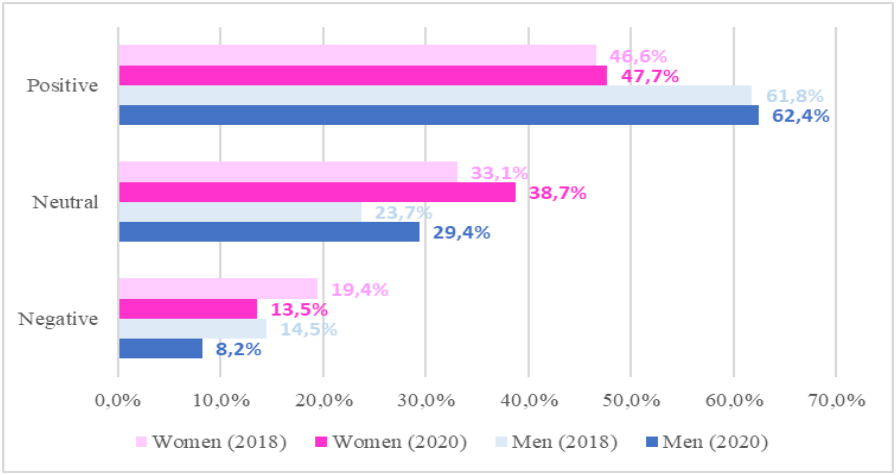


Source: own construction

The overall perception of self-driving cars was measured on a 5-point Likert scale for international comparability. The general perception among men is clearly more favorable in both years. Notable, however, for both sexes is a relatively significant

(approximately 6 percentage points) decrease in the histogram of negative opinions and an increase in the column of neutral and positive opinions for both sexes (Figure 2).

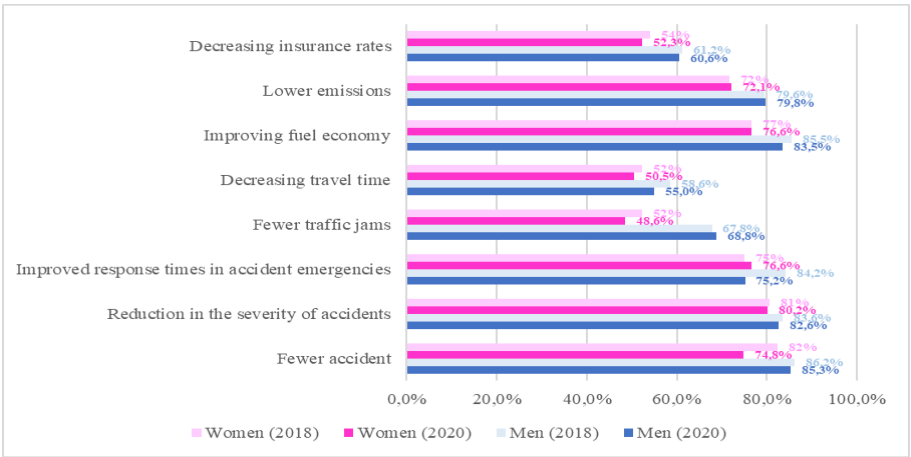
Figure 2 General opinions on self-driving cars by gender in 2018 and 2020 (%)



Source: own construction

In the next question, respondents were asked to indicate how likely they were to see the occurrence of certain events with a positive outcome. The result is remarkable: women in both years, without exception, are less likely than men to expect any positive outcome (the largest difference is 20.2 percentage points). Women in this case are clearly significantly more pessimistic than men (Figure 3).

Figure 3 Probability of occurrence of positive events by gender in 2018 and 2020 (%)

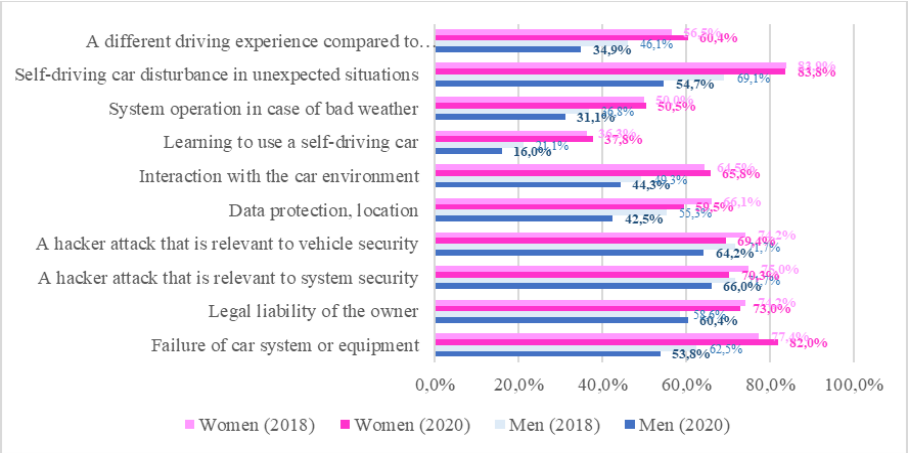


Source: own construction

We also asked about the most common concerns that the international literature has revealed about self-driving cars. It can be seen in Figure 4 that in both years, women

gave higher values in all cases, i.e., disturbing events were more likely to occur in women than in men (the largest difference was 29.1 percentage points). Even in this case, women are more pessimistic than men. All this is statistically significant according to the following in 2020: failure in the car system (χ^2 = 19.895, sig = 0.000), legal liability of the car owner (χ^2 = 3.888, sig = 0.049), data protection (χ^2 = 6.276 sig = 0.012), interaction with the environment (χ^2 = 10.07, sig = 0.002), learning to use the car (χ^2 = 13.017, sig = 0.000), system operation in case of bad weather (χ^2 = 8.364, sig = 0.004), confusion in unexpected situations (χ^2 = 21.645, sig = 0.000), different driving experience (χ^2 = 14.077, sig = 0.000). The values of the Cramer coefficient show a medium to strong relationship in several cases.

Figure 4 Probabilities of occurrence of disturbing events by gender in 2018 and 2020 (%)



Source: own construction

Examining the topic of renting and owning, a larger proportion of women – 68.5% in 2018 and 73.9% in 2020 – are concerned with this option. In the case of men, this proportion was smaller, in 2018 there was only a 10 percent point difference in action, while this year the gender difference in these positions reached almost 20 percentage points. 41.4 percent of men surveyed said in 2018 that they would be interested in owning such self-driving technology, compared to an increase in this year, with 45.3 percent voting the same way. Analyzing the issue of additional costs, it can be seen in 2018 that 73.2% of domestic respondents would not be willing to pay them, compared to 76.6% based on this year's data. For men, this proportion was much lower in 2018, as only 57% of them would not have issued extra costs, in 2020, this proportion showed a slight decrease to 55.9%. It was also observed in the case of women and men that the higher the level of education, the more they expressed their positive opinions, and it was characteristic of men that they showed negative and neutral attitudes to a greater extent with a lower level of education. For women, this was observed at the neutral response option.

Over the course of two years, it has been observed that there has been a positive shift in women's and men's perceptions of self-driving cars. The more information the research participants have, the fewer rejection can be discovered.

5.3. Moving emotion research

The questionnaires provided answers to how opinions about self-driving cars differ by gender, and how these change over time. Netnography was apt to explore and categorize the underlying attitudes, which revealed that the concerns of negative contributors were related to specific topic groups. At the same time, we did not get an answer to the question of what the reasons are behind the attitudes, and how they change as a result of our own specific experience, and what emotions these experiences evoke.

To answer these questions, we defined a special in-depth interview in which we screened a short film to our subjects while asking about their emotions. Nowadays, the research of emotions has developed into a multidisciplinary field. Psychologists have long been involved in the study of human emotions (Fernández et al. 2019, Siedlecka et al. 2019). The aim of these procedures is to examine the expressions, behaviors, and thoughts of participants under the influence of certain stimuli and to better understand and understand our emotions (Fernández et al. 2019). Audiovisual materials are one of the best-used and most accepted techniques for evoking basic emotions, as they can evoke very real-life stimuli from humans (Fernández et al. 2019, Siedlecka et al. 2019).

The experiment involved 34 people, 17 men and 17 women. The youngest participant was 20 years old and the oldest was 66 years old. Subjects' driving experience ranged from 0 years to 45 years. Residents of both small towns, medium and large cities were included in the sample.

The short film was deliberately put together so that the subject always had to go through a new situation as follows:

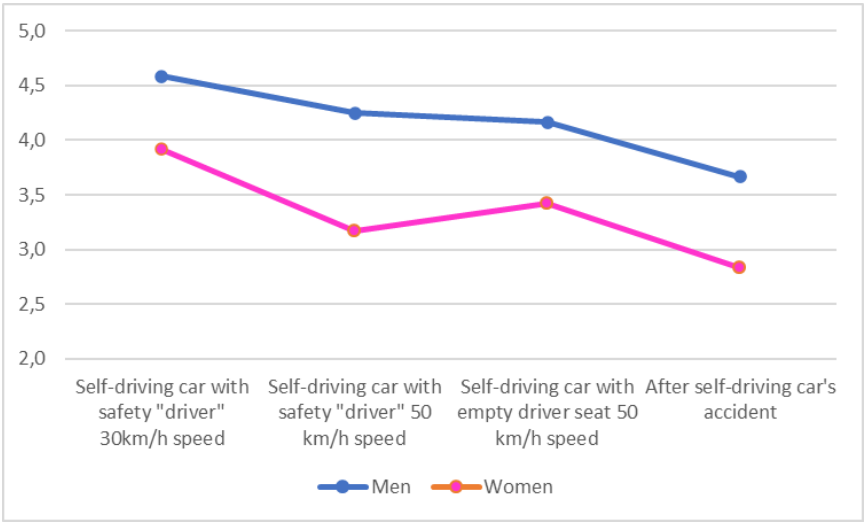
1. self-driving car with safety driver at low speed
2. self-driving car with safety driver at high speed
3. self-driving car without safety driver
4. a self-driving car has an accident and overturns

In relation to what was seen in the video, the goal was to gradually build confidence in self-driving cars from the perspective of respondents, all by involving and presenting increasingly complex traffic situations. In each case, we assessed on a scale of 1 to 6 how, based on what they saw, respondents would judge their sense of security if they were sitting in the car seen in the video. And after building gradual trust, after an accident, we wondered how they would respond to the level of trust associated with the technology. Did all this change the level of trust or did it not affect you at all? We wondered what might be behind the more dismissive behavior of women, and we compared all these responses with male responses.

During the experiment, male and female polarization were clearly demonstrated both in the perception of security and in the process of opinion formation (Figure 5). In all four simulated situations, women experienced a 17–34% lower sense of security during the experiment than men. The biggest difference was when the self-driving car was still driving with a safety "driver" but at a higher speed. Women were emotionally based *("shocked that no one was sitting in the driver's seat"),* men lined up rational

reasons *("it's already a mature technology, it can't be wrong")* behind their sense of security (or lack thereof). Among the basic emotions, women felt the most surprise and fear.

Figure 5 Mean values of the feeling of security by examined situation, by gender (on a scale of 1–6)



Source: own construction

An important result of the in-depth interview emotion research is that the results of the large-sample questionnaire surveys on the marked rejection groups are only partially confirmed: a significant difference between men and women was detected in this case as well. In the latter cases, the traffic, and emotional situations previously experienced, which the video seen brought back to the surface, are much more important than the demographic status. That is, someone was more dismissive than emotion research because they were older or because they live in a smaller settlement, but because they were reminded of the previous negative life situation of the situations they experienced in the experiment. This is an important result in terms of the fact that due to the complexity of the topic, it is also very important to explore the underlying causes.

We have also shown that newer information can make dismissive behavior accepting. A particularly interesting result of the experiment was that in 40% of the participants in the experiment, the sense of security against our expectations did not decrease when the safety driver was removed from the picture. These subjects indicated an unchanged or increasing sense of security on the grounds that *"I am already accustomed to this situation, no longer bothered that no one is driving".* That is, the relationship between increasing information and acceptance can be clearly demonstrated, and that once you see and experience how technology works, your acceptance increases.

5.4. Virtual reality simulation

The results of the methods presented above showed that the closer subjects can feel about what self-driving is all about, the more they have a positive attitude towards technology. This gave us the idea to look at what happens when people get one step closer to the real feeling, i.e. we called virtual reality for help. We conducted an empirical experiment in a simulated self-driving car test. Our aim was to examine the reactions and feelings of humans towards self-driving cars, selected from rejection groups, and whether virtual reality experiments can help in the acceptance of this technology in the social groups mentioned above.

During the experiment, smartphone-compatible VR goggles were worn by the subjects, through which we presented a self-driving car simulation implemented by the Wind River application. Meanwhile, a blood pressure monitor was installed on each participant to measure any increase or decrease in blood pressure and heart rate while showing the 1.5-minute video, which represents different kinds of traffic situations. When the participant turns his/her head, he/she can see the surrounded environment and the moving car ahead. It was very interesting, but no significant differences were observed in heart rate and blood pressure, but some changes were measured in all cases.

16 people participated in the experiment. Unfortunately, due to the COVID-19 epidemic, there were difficulties in surveying the higher number of participant because the experiment requires a face-to-face meeting. We would like to emphasize that the device also covers the nose, for this reason extreme care had to be taken and therefore the number of people in the experiment was less than planned. For this reason, our goal changed slightly to see if VR is getting any closer than previous studies, and if so, this might be continued and deepened in the future. During the research, we focused on the attitudes and emotions of women and the elderly (over 60 years of age). The participants came from different parts of the country and were made up of different age groups, which helped us to approach the problem in as diverse a way as possible, and to gather as much information as possible about the expectations and opinions of the respondents regarding self-driving cars.

Prior to the start of the experiment, all participants expressed curiosity and excitement. Prior to the start of the research, as they saw the VR goggles, all older participants and all women showed fear, as none of the participants had yet encountered this device and the women called the technology bizarre. Moreover, all participants in the experiment said that they had not tried small virtual reality glasses before, so they did not have the benchmark of previous experience. It can be concluded that the experiment and its results made it possible for the participants in the research to gain experience with driverless vehicles before they are placed on the market.

When asked how safe they felt when traveling by the car on a scale of 1 to 6, the average for both women and men was 5.8, and for both sexes, those in the older age group were those who gave a lower value to safety than the average. Examining how well the subjects felt, there was also a similarity in terms of gender in the case of the averages, as we obtained a value of 5.6, in which case those over 60 years of age also gave a lower value.

Table 1 Comparison of characteristics of female and male participants' opinions

Changes of trust in a self-driving car during the experiment	Women's opinions Positive displacement	Men's opinions Positive displacement (to a greater extent)
Characteristics of attitudes towards self-driving cars	Surprise Consternation Excitement Joy Enthusiasm More emotional Experience orientation Comfort Sensitivity of the system	Surprise Consternation Joy Enthusiasm Desire for adventure Experience orientation Issues due to loss of control Risk of system failure
Subjective impressions gained during an experiment	Throughout the experiment, the participants were characterized by excitement, perception of relaxed expression. Less openness to real trying.	Throughout the experiment, the subjects were characterized by excitement, a desire for adventure, and a perception of confident expression. Openness to real trying.

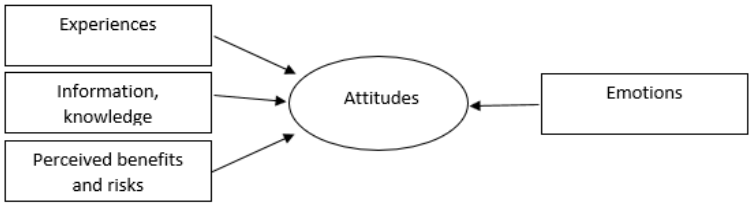
Source: own construction

The young respondents were characterized by joy after the experiment. They looked back on the virtual reality simulation as a huge experience. The older age group was characterized more by a neutral facial expression after the experiment. It was more characteristic of the young women that they expressed their emotions more strongly. During the experiment there were joyful cries and surprised reactions as well.

We concluded the study by again asking the subjects how much they would trust the self-driving car after the experiences they experienced, reminding them how much value they gave before the experiment on a scale of 1 to 6. All participants gave a higher value one by one than we initially experienced. For women, this averaged 5.1 (0.7 percentage point increase) while for male subjects it was 5.4 (1 percentage point increase) on average. In the case of women, again, the subject over 60 gave a lower value, and in the case of men, the older value was lower.

Our research methods prove that consumer attitudes and opinions about self-driving cars are greatly influenced by information about technology, our previous experience with motor vehicles, and the potential opportunities and dangers with self-driving cars, and last but not least by emotions, a sense of security being the most important.

Figure 6 Factors influencing attitudes towards self-driving cars



Source: own construction

Based on our results, we believe that attitudes towards self-driving cars are strongly influenced by the information and knowledge gained about them, any experience with motor vehicles, the perceived benefits and risks of self-driving cars, and emotions where safety is dominant (Figure 6). The research clearly demonstrated that as information increased, the difference in attitudes between women and men narrowed. Hence, it was shown that increasingly sophisticated methods, on the one hand, helped to pass on more and deeper information to the participants, and on the other hand, were able to blur gender differences.

6. How to improve women's attitude about self-driving cars?

In our study, mostly, the qualitative results show that the Hungarian women interviewed are significantly more reluctant to drive self-driving cars than men. As the proportion of women drivers increases year by year and has already exceeded 50% in the US, women represent a critical mass of rejectors who are able to negatively influence the spread of self-driving technology. Thus, self-driving technology developers also need to focus on social aspects, including rethinking their *"women's strategy".*

The empirical survey of our study clearly concluded that acceptance increases with awareness: the more informed the respondent, the more likely he or she is to accept self-driving cars. We have also shown that newer information can turn dismissive behavior into accepting in the case of Hungarian respondents.

It follows from all this that women's attitudes towards self-driving cars can clearly be improved by providing them with more information. The exact way to do this is a very diverse topic, the detailed elaboration of which is the task of a wider professional community. The framework of our present research is realistically only suitable for outlining the basic ideas that, based on our research, can serve as an important input for the development of specific actions. Based on our results, it can be concluded that the female attitude towards self-driving cars can be effectively influenced if the *"women's strategy"* meets at least the following criteria:

1. *Messages and content specifically tailored to women:* the psychological aspects of women's opinion-forming must be considered (emotion-centered, colorful messages, etc.) (Meloni et al. 2014, König–Neumayr 2017, Anagnostopoulou et al. 2018).

2. *Indirect messages:* as the automotive industry is not a priority for women, it is proposed to link the messages to topics that are of particular importance to women (beauty, children, animals, gastronomy, travel, entertainment, etc.).

3. *Quick messages*: Women prefer very quickly-consumed messages that can be processed in a fraction of a second: a simple sentence and associated visual content.

4. *Simplified*: women prefer easy-to-understand messages that they can process while multitasking: infographics, visually acceptable solutions.

5. *Entertainment content:* Women prefer entertaining content over educational content. This is true for both the theme and the appearance: a light theme with moving (video, gif) packaging is most effective (Anagnostopoulou et al. 2018)

6. *Selecting "women's channels":* It is extremely important that messages are delivered to women through a channel that they use daily. For example, the majority of Facebook, Instagram, and TikTok users are women, but the proportion of female users on Pinterest is 25% higher. All this also opens space for influencer marketing.

7. *Chat-like messaging:* Messenger is an interface used by billions of women daily (Statista 2021). You may want to implement chatbot enhancements that can be a powerful tool for women by offering ask-and-answer options.

8. *Innovative, attention-grabbing solutions*: in the long term, the topic of self-driving cars can be effectively brought to women's attention if they are served in some exciting way: VR experience, trying a self-driving car, etc. (Schrammel et al. 2015).

In our view, strategies based on the above key considerations are appropriate to take the first steps to ensure that self-driving car developers consider and address the attitudes of a large rejection group, women. If we consider the result of our research to be globally valid, according to which increasing awareness reduces the rejection of self-driving cars, the application of our suggestions could positively influence the attitudes of women towards self-driving cars.

7. Conclusion

This decade could see a significant step forward in self-driving car technology. In our study, we pointed out how the proliferation of self-driving cars could bring drastic changes to the daily lives of all societies. This new solution will change transport in a way that nothing else has done in the last hundred years, but the transition time may take decades and will not be smooth These changes could fundamentally change our daily routines and decades of habits, and affect our travel habits, the business models around us, our networks, and the image of our environment. This system creates the opportunity to eliminate traffic jams, drive faster, put less strain on our environment, have fewer accidents on the roads, or even have green areas and public spaces in place of the current car parks and not have our own car in the future.

All in all, the prevalence of self-driving is a huge problem in our era. We highlighted the problems that (i) with very few exceptions, self-driving car developers focus exclusively on technological development, (ii) the projected drastic change is much closer than what could be realistically prepared for at the social level, (iii) self-driving cars represent the technology from which we could benefit the most, and (iv) there is no strategy to shape the attitudes of rejecting groups. As women represent half

of all drivers in order of magnitude, neglecting their rejection could delay or even jeopardize the successful introduction of the technology as a whole.

The clear conclusion of our study was that in the case of the Hungarian respondents' acceptance increases with awareness: the more informed the respondent, the more likely he or she is to make an accepting statement about self-driving cars. We have also shown that newer information can turn dismissive behavior into accepting in the case of research participants.

It is therefore necessary to extend development work to the social sciences, with a special focus on rejection groups (especially women), thereby accelerating social adaptation for humanity to be able to process the projected drastic change. The aim of this study is not to convince rejection groups of self-driving technology, but we consider it of paramount importance that information be provided to society by appropriate means. In addition to information, we believe that consumer involvement is also a priority in approaching the topic.

With our results, we would like to draw attention to the fact that the topic requires an interdisciplinary approach, as technological development is not enough, but social science aspects must be included in innovation processes, with a special focus on clearly identifiable segments such as women.

Acknowledgments

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Competition law approaches related to the operation of Airbnb in Budapest

Áron Drabancz – Nedim Márton El-Meouch

In our study, we examine the operation of Airbnb among the sharing-based companies. We review the operation of Airbnb, the European and American regulatory systems, and examine the economic results of each regulation (e.g. a limit on the number of short-term housing days). Our initial hypothesis is that a regulatory framework can be developed in Budapest, in which the operation of the company is possible without the lives of the residents becoming impossible. In our study, we try to map the economic implications of short-term housing renting with a simple microeconomic calculation and a spatial simulation. Based on the results of our research, the 120-day restriction on annual short-term rent could eliminate investment-type short-term renting and contribute to the reduction of "party districts" in Budapest. An agreement with Airbnb could increase state tax revenues and create a more level playing field between hotels and short-term housing platforms. Our regulatory framework would largely eliminate the negative externalities associated with Airbnb, but at the same time, the positive returns would be greatly reduced.

Keywords: Sharing economy, real estate market, regulation

1. Introduction

The spread of companies and market participants in the sharing economy can significantly transform the economic structure of countries, which can be linked to the development of new competition law regulations. In a sharing economy, the consumer transfers his or her own product and related service to another member of society, so that the economic transaction takes place between consumer and consumer. During the 20th century, business-to-business (B2B) transactions and, at the end of the production chain, business-to-consumer (B2C) transactions were dominant. Through economies of scale, concentrated production and sales, and specialization, companies could become dominant actors on the supply side for the first time since the unfolding of the Industrial Revolution. At the dawn of the 21st century, however, energy-saving considerations, attitudinal and lifestyle changes, and Internet applications have made it possible to connect consumers to consumers (C2C), i.e. lead to a high degree of sharing of unused assets in the possession of the individual. Companies using C2C solutions are gaining significant ground in the world economy (e.g. Uber, Airbnb, Couchsurfing) and in Hungary (Oszkár Telekocsi, Rukkola) as well. Companies connect consumer demand and supply through online applications, where the unused capacity of consumers is the product or service typically offered. Companies using a sharing economy solution can have a significant impact on a country's economy: sharing unused resources – e.g. hedge trimmers, cars, real estate – can increase the volume of economic events not measured by GDP, as well as improve the efficient use of natural resources. Sharing can create a significant consumer surplus, as online platforms significantly reduce the transaction

costs of handing over devices, so the sharing of products and devices with each other can divide the price of a product between its users. However, the regulation of sharing-based businesses is still rudimentary in most countries, mainly due to the immaturity of companies and solutions, their sometimes too rapid spread, and the fact that consumers are facing each other in a novel way on the demand and supply side.

In our study, we examine the operation of Airbnb among the companies based on sharing. We chose the company because more than 13,000 apartments were rented out via Airbnb in Budapest before the coronavirus (Airdna 2021), which may have significantly contributed to the real estate market price increase in Budapest in recent years. Furthermore, the noise associated with the spread of short-term housing rentals also affected the well-being of those living there, with residential communities trying to limit the operation of Airbnb through regulations and bans. Comprehensive legislation on short-term housing rental was introduced in the summer of 2020, in which the government gave municipalities the option to regulate their directly managed areas individually (Parliament 2020). The timing of the adoption of the legislation is not coincidental, as the precautionary measures introduced in response to the coronavirus have decimated the number of tourists arriving from abroad, with the result that the number of apartments available for short-term stays has roughly halved in 1 year (Airdna 2021, Gabay 2020). The period of reduced tourism caused by the pandemic provides an opportunity to think through and implement the regulatory actions that were previously delayed, in order to keep economic aspects and the quality of life of local people compatible even with increasing tourism. In the analysis, we basically formulate regulatory proposals from the viewpoint of local residents, based on their interests. The main reason for this is that regulations are motivated by the goals of local residents, and their choice determines the political picture, and thus indirectly the regulatory steps. Our initial hypothesis is that a regulatory framework can be developed in Hungary where the operation of the company is possible without the lives of the residents of Budapest becoming impossible. Our main goal is to examine the economic outcomes of the annual limit used in many countries for short-term housing rental days. Our hypothesis is that if an apartment can only be used for Airbnb for a certain period of time in a year, it has a significant effect on market processes. Furthermore, we examine the possible clustering of Airbnb flats, and by running a simulation we show that flats rented out for the short term are starting to cluster around each other in the long run. In order to prove the hypotheses, in the first section we present the operation of Airbnb, in the second section we present the international and Hungarian regulatory framework in relation to the company before the coronavirus. In the first subsection of the third section, we build a microeconomic model where we show how the spread of Airbnb may have affected property prices, the well-being of residents, and the prices at which the market for short- and long-term housing will be balanced. In the following subsection, we run a simulation regarding the location of short-term housing rentals. In the fourth section, we summarize the results and make recommendations for some elements of the Hungarian Airbnb regulatory framework.

2. Operation of Airbnb

Airbnb is a private company founded in 2008, its main activity being the pairing of accommodation hosts and accommodation seekers through an online platform. The company's main revenue comes from the costs charged from matching supply and demand: accommodation bookers have to pay a 3% transaction fee after their booking, and accommodation hosts pay a 10% commission to the company. The company's shares have been traded on the stock exchange since 2020, the company's market capitalisation exceeds the combined value of the four largest hotel chains (Carville et al. 2020). The perception of how Airbnb works is extremely divided, which is basically due to its sharing-based model. The potential advantages and disadvantages of Airbnb are described in Table 1.

Table 1 Identified advantages and disadvantages of Airbnb

Advantages	Disadvantages	Advantage and disadvantage as well
Growing income of homeowners	Host and user risks	Intensified competition due to the accommodation of tourists
Increase in the number of tourists	Increase in noise levels and littering in apartments and districts	Rising house prices
Sharing of the resources	Residents being pushed out of their homes	Increase in sublease prices
	Possible tax evasion	

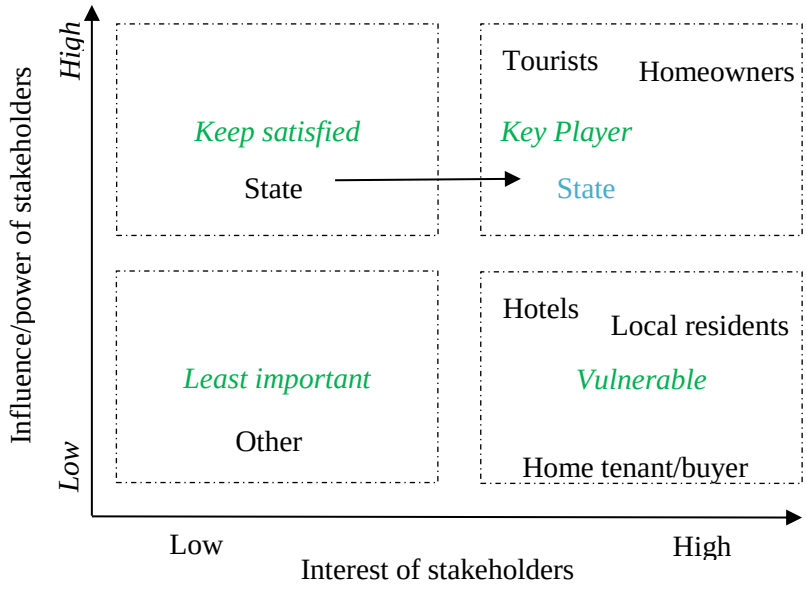
Source: Own construction

Residents renting out their homes for the short term can earn money, and tourists can spend the night in a cheaper, more authentic and more people-friendly environment. Lodgings much smaller than hotels can provide accommodation further away from the main tourist destinations, thus boosting regional tourism in some regions. And the sharing of resources and flats can increase the total resource usage. However, connecting consumers to consumers also involves risks, the company does not always compensate for damage caused by guests, and despite previous evaluations, the guest may find a living environment that he did not expect. Furthermore, regulation of Airbnb accommodation, which is less stringent than for hotels or even not yet in place, results in unequal competition in the tourism market, allowing landlords to start renting the apartment on a system-wide basis for more than 360 days a year or to choose to rent more apartments simultaneously (Comprehensive Survey 2016). This forces hotels to compete on price, leading to consumer surplus. By then, however, the housing and resource-sharing motive will disappear, meaning that homeowners rent out their homes for short-term rather than long-term due to profit-oriented purposes and even buy new homes for investment. Thus, Airbnb apartment blocks could arise, which could displace local residents due to high noise and dirt and make downtown living conditions impossible to bear. In parallel with the increase in the supply of short-term housing

rental, the supply of long-term housing rental is narrowing, so the local population is facing higher real estate prices, and residents are lagging behind tourists in price competition. The essence of the sharing economy is that it creates added value through the release of unused capacity without producing a new product, so we tend to view housing rental different to this motive more negatively.

To synthetize the thoughts written above, we perform a stakeholder analysis concerning the influence the different agents have on the spread of Airbnb and the impact it has on them (see: Olander, 2007, 280). We divided the stakeholders into 4 sub-groups depending on the degree of influence and impact (Figure 1). In this analysis, the most important key players are the price-sensitive tourists and the home-owners, who could decide between renting out their home on the short- or long-term housing rental market. They basically constitute the demand and supply side of the short-term housing market, for which Airbnb provides a platform. The least important sub-group in this matter consists of all those not directly affected by the spread of Airbnb (i.e.: non-local residents, rich tourists or those who usually do not go on vacation, those who do not seek to buy or rent an apartment for long-term etc.).

Figure 1 The influence and interests of the stakeholders in connection with Airbnb



Source: Own construction

In the vulnerable sub-group, the agents do not have high influence on the spread of Airbnb, though it has a high impact on them. The group consists of the local residents, hotels and residents, who want to rent or buy a home in the neighbourhood. Another stakeholder is the state, who has a high potential to regulate and control the spread of Airbnb, and its interest could be significant concerning the issue, like a tax revenue and even as a social problem if the spread of Airbnb greatly exacerbates the relationship between locals and regulating power. It means that when there is no social outrage in

connection with Airbnb, the state is acting like a high influence-low impact stakeholder, since it has the potential regulatory power, while as social pressure increases, impact also becomes an increasingly important factor for it (see Figure 1). As the vulnerable group has increasing concerns in connection with Airbnb, the state is required to step in as a legislator in favour of them, but it is important that the key players' situation and the functioning of the market is not made impossible. That's why we think new regulation is needed in the case of potential negative externalities affecting the vulnerable group. Aside from that, we believe that a well-regulated community house sharing market can intensify competition for tourist accommodation and thus have a positive return. The aim of our study is to determine whether the reduction of exclusively profit-oriented short-term housing rental can be achieved by introducing an annual daily limit on the homeowners for housing rent, without making it impossible for actual house sharing to function.

3. Regulatory environment

In the next section, we present the main foreign regulations affecting major developed countries before the coronavirus, and briefly describe the situation in Hungary.

3.1. International regulatory environment

United States of America

In 2016, two of the 5 cities with the most Airbnb ads (New York and Los Angeles) were in the United States (McCarthy 2016). In the US, cities and states individually have a great deal of autonomy to regulate Airbnb, so we can come across a wide range of solutions in the country. However, most of the time, one common point of the regulations is that their purpose is to register short-term housing rentals and thus to include the tax liability of homeowners renting out their house subject to regulation. Furthermore, a typical regulatory step is to impose tax conditions similar to the hotel sector, which, by definition, seek to create a level playing field between hotels and advertisers on the online platform in the short-term housing rental market. Nothing proves the social acceptance and legitimacy of registration and the tax regulation better than the agreements where Airbnb undertook to collect tax liabilities and then deliver them to cities (e.g., New Orleans, Portland, Los Angeles) (Airbnb 2017). Another common point in the various regulations is that for properties that are not used personally by their owner (they do not live in them), the relevant rules are either much stricter or the activity is completely prohibited. Portland's regulation concretizes the issue: for homes where owners do not stay for a total of at least 9 months in a year, short-term rentals are not allowed, these homes are not considered homes of primary residence (Njus 2014). Typical restrictive measures include a one-year limit, i.e., the maximum number of days a home can be rented out in a year. This is not inducted for all cities/states, but where it is, it typically means a 30-, 60-, 90-, 180-day limit and tries to help reduce short-term housing supply. The rule of maximum number of guests that can be accommodated at the same time is trying to eliminate neighbourhood complaints, i.e., the formation of "party apartments", such as the Austin ordinance's limit of 10

adults or 6 unrelated adults (White 2016). A similarly motivated measure introduced in the Sacramento area is the notification obligation that requires a landlord to notify those living within 60 feet of the home about the rental of the apartment (Garrison 2016), or the Louisville regulation requiring a person to be named, who is not more than 40 km away from the site at the time the apartment is rented out, so he or she can take action in the event of a complaint (Bailey 2015).

In many cities, resistance to Airbnb has led to regulations that may have had the goal of making it impossible to rent out homes in the short term. The Chicago ordinance, for example, also regulates the number of homes that can be rented out within a residential building and allowed districts themselves to vote on a ban on short-term housing rentals (Lentino 2016). This is one of the most stringent laws in the U.S., and civilians have since twice challenged the ordinance in court for unconstitutionality (Marotti 2016a, Boehm 2016a), which led the court to later suspend the ordinance (Marotti 2016b). The same fate befell on the Nashville ordinance, where unconstitutionality was also found (Barchenger and Garrison 2016) because regulation was overly vague and complicated. In the case of New York, San Francisco, Santa Monica and Anaheim, the regulations were challenged by Airbnb on the grounds of unconstitutionality. These regulations also regulated the short-term housing rental market very strictly. In New York, it was illegal to rent out an apartment for less than 30 days, with the ordinance intended to penalize Airbnb for all homeowners advertising illegally on the site (Benner 2016a). The end of the legal dispute was an agreement that only advertisers could be penalized by the City of New York instead of the online platform (Benner 2016b).

There are far fewer examples in the US of regulations that are not strict but are online platform-friendly and specifically targeted at Airbnb and similar short-term housing issues. Regulations favourable to platforms such as Airbnb are adopted typically at state level. This is also the reason why Airbnb seeks to negotiate at state level in several states where no agreement has been reached at city level, thus circumventing the agreement with strict urban decision-makers: an initiative with this purpose can be seen in Tennessee (Garrison 2017) and Texas (Alfaro 2017). This negotiation strategy can be effective for Airbnb, as Member State regulations could override city regulations. Further examples of state regulations in favour of Airbnb are the cases of the states of Virginia and Indiana, where regulations stipulate that cities in those states may not prohibit short-term housing rentals provided by Airbnb and similar online platforms (Boehm 2016b, Sikich 2017). Of the states, it is clearly the state of Arizona that is specifically trying to support Airbnb's operations, encouraging further growth. The state has also banned cities from banning similar online platforms and has not imposed any restrictions on them, either an annual limit or a limit on the number of flats that can be rented out per person (Kerr 2017).

Overall, it can be said that the regulations of US cities/states are extremely diverse, and that there are many ways to approach the regulation of the short-term housing rental market. In addition, it can be noted that the regulations on short-term housing rentals are typically stricter in cities with large populations and visitor numbers (in some cases they are practically prohibiting it from operating). This may be because interest groups with negative externalities are better able to express their views to urban decision-makers, while in state negotiations, stakeholder groups lobbying is likely to have less influence on legislation, regulations are market-oriented, thus favouring Airbnb.

European Union

The major cities in the European Union are the biggest destinations for Airbnb tourists, with 6 of the 10 cities with the most advertisers being cities of EU member states in 2016 (McCarthy 2016). In terms of taxation and registration, EU cities follow similar guidelines to US cities, with the goal of creating market competition in the short-term housing rental market. For three cities/countries, Airbnb also collects the tax from its users and then forwards it to the city: Paris (and the whole of France), Amsterdam and Lisbon (Airbnb 2017). The joint agreements have also led to closer cooperation. On the one hand, in March 2016, Airbnb agreed with Paris to warn illegal advertisers (an unoccupied home being offered for rent, or the 120-day limit has already been exceeded) in a letter (Coldwell 2016). On the other hand, at the end of 2016, Airbnb undertook in a contract to monitor the achievement of the annual renting limit for apartments advertised in London and Amsterdam (London - 90 days, Amsterdam - 60 days). If this limit is reached by homeowners, Airbnb staff removes their ad from the site (Woolf 2016). As far as typical regulations are concerned, in EU cities/countries where there is a limit, it is between 60 and 120 days. Like in the US, regulation can also be found where the number of guests is maximized, which means 4 guests at a time for Amsterdam (DutchNews 2017). In addition to the usual standards, we found some surprisingly specific requirements for apartments: in Madrid internet access is mandatory (Stucklin 2015), while in Athens, according to the provision, services other than accommodation, such as dining, should not be provided to guests in the apartment in order to not put the local service sector in a disadvantageous position, whose revenues are largely determined by tourist consumption (Kousounis 2016).

In the case of European Union cities in general, strict regulations are much more typical. Barcelona is at the forefront of this, as it was the first city to penalize Airbnb. The company was first hit in 2014 with €30,000 (Kassam 2014), in 2015 with €60,000 (O'Sullivan 2015), and in 2016 with €300,000 (Badcock 2016) in penalties. Interesting in this resistance is that the regulation did not change the Barcelona authorities' legal assessment of the activities of the online platform, which was considered illegal by them, as the first penalty was imposed before the regulation, while the second and third penalties were imposed after the regulation. The Berlin regulation practically banned short-term housing rentals with a decree that came into force in 2016 (after a two-year trial period) that only homes in certain parts of the city can be rented out and only with a permit (Vasagar 2014). The issuance of permits, on the other hand, is minimal, as evidenced by a statement from decision-makers in one of the districts that 95 percent of submitted permits will not be accepted (Oltermann 2016), making short-term housing rentals in the city virtually impossible. There is also a strict rule in Brussels as well as in Luxembourg, in Brussels an apartment can only be rented out if it is approved by the residential community (Boyle 2015), while in Luxembourg the profit from housing rental is accounted for as business profit and is therefore subject to a much higher tax burden (Luxemburger Wort 2016).

With regard to Airbnb and short-term housing rental, in addition to the example of Amsterdam (and London) (where the two sides negotiated throughout the regulation), Portugal is also worth highlighting. In Portugal, owners can rent out their apartment without any annual limit, and the number of rooms is not limited by the regulation, they

can rent out any number of rooms to tourists (Minder - Scott 2014). In addition, the Lisbon city administration has sought to simplify processes (together with Airbnb, as they collect the tax), thereby also encouraging homeowners to register as well as to pay taxes (Airbnb 2016). Presumably, the importance of tourism to the country and the positive impact on employment opportunities for those living from tourism may be the cause of the behaviour of Portuguese decision-makers towards Airbnb.

Regarding the relationship between Airbnb and the cities/countries of the European Union, big cities on the old continent as a whole are particularly strict about the online platform. This may be the reason why, based on the US example, Airbnb is trying to negotiate and conclude agreements at the country level (cf. TheLocal 2017). In addition, it is typical for EU countries to regulate short-term housing rentals in the rest of the country based on the agreement of the big city (usually the capital): this is the case in Belgium (Johansson 2016) and also in the Netherlands (DutchNews 2016).

3.2. The Hungarian regulatory environment

Comprehensive regulation of Airbnb has become necessary in Hungary, as the number of apartments advertised through Airbnb almost tripled between 2010 and 2019, and Airbnb apartments already make up a substantial part of the community accommodation market today (Airdna 2021). The spread of Airbnb is basically limited to the capital, in most counties the number of advertised apartments is typically less than 100, while in Budapest this number exceeds 5,800.[7] In addition, the shared nature of housing rental does not dominate among housing rentals, as in Budapest homeowners rent out the entire apartment for a shorter period of time in 88.7%, rent out a room only in 10.5% and share a room with others in 0.8% (Airdna 2021). This means that, in essence, it was the spread of Airbnb that has allowed homeowners to rent out their homes, which have so far been rented for the long term, for short-term stays due to economic reasons. The new option could have provided a higher income for owners renting out apartments in Budapest, but it could have increased the prices of apartments and the general noise level of condominiums. The residential communities in Budapest are seeking to eliminate and reduce the above-mentioned negative externalities in different ways.

Due to the spreading Airbnb fever, housing communities have tried to achieve a reduction in the rate of short-term housing rentals in their housing community by convening residential assemblies and amending the organizational operational rules accordingly. The Curia of Hungary's BH Resolution No. 117 of 2016 took a position in this matter, according to which the co-owners may validly restrict the non-residential activities in the apartment of the co-owner. Comprehensive regulation on short-term housing rentals was made in the summer of 2020, delegating the creation of conditions to local governments (Parliament 2020). Most rural settlements and Budapest municipalities have not yet established their own regulations, but initial steps have already been taken. According to the plans, in Terézváros, in addition to the permit of the condominium and the registration of the accommodation, the provision of 24-hour availability of the operator to the residents of the condominium and the posting of the condominium policy in English were included in the regulations (Portfolio 2021).

[7] As of May 4, 2021.

4. Modeling

In the following section, we wish to better understand two Airbnb-induced processes using models. In one of them, we analyse price processes in the short- and long-term housing rental market using a simple microeconomic model. Equality of supply and demand and the condition of transaction-free passage between the two markets allow us to model the development of prices between the two markets. The second, spatial simulation model, simulates the clustering of Airbnb flats with the spatial location variable and by capturing the transaction cost of the movement between the two housing rental markets. The first microeconomic model thus analyses the price dynamics of short- and long-term housing rental market and seeks to answer how to reduce the number of people renting their apartment short-term who are purely profit-oriented. The second, spatial model examines the location of Airbnb apartments and the chances of party districts developing. Our first model is simple, has few variables, so its parameters can be better estimated, and the logic of market price development can be better illustrated with it. Our second model is more complex, but therefore the parameters of many variables cannot be estimated, and they are based only on priori assumptions. It follows that the results of this model may seem significant, going beyond the presentation of the Airbnb apartment clustering, but due to the many parameters which cannot be estimated, no serious conclusions can be drawn from the model. Rather it is appropriate only to identify long-term trends.

4.1. Equilibrium prices for short- and long-term housing rentals

We would like to illustrate one of the main disadvantages of Airbnb, the increase in prices in the market of apartments used for living, with a microeconomic model. It is important that we examine two well-separable markets and their relationship to each other during modelling. We distinguish between the short-term housing rental market and the long-term housing rental market. This is due to the fact that the short-term housing rental market (hereinafter: STH) has to comply with different regulations, other competitors (hotels, apartments) are present and the consumers of the market can be well separated (mostly tourists) compared to the long-term housing rental market (LTH).
The basic equations of the model:

Baseline scenario, Airbnb is not yet in the STH market, no passage between markets

Short-Term Housing rental market:

Supply: $Q_{S,STH} = a + b * P_{1,STH} \rightarrow P_{1,STH} = \frac{Q_{S,STH} - a}{b}$

Demand: $Q_{D,STH} = c - d * P_{1,STH} \rightarrow P_{1,STH} = \frac{c - Q_{D,STH}}{d}$

$\Big\} P_{1,STH} = P_{1,STH}$

$\frac{Q_{S,STH} - a}{b} = \frac{c - Q_{D,STH}}{d}$ /Demand and supply are equal in equilibrium,

$Q_{S,STH}=Q_{D,STH}=Q$.

$Q_{1,STH} = \frac{a*d + b*c}{b+d} \rightarrow \boxed{P_{1,STH} = \frac{c-a}{b+d}}$ /An equilibrium price is formed.

Long-Term Housing rental market:

Supply: $Q_{S,LTH} = e + f * P_{1,LTH} \rightarrow P_{1,LTH} = \frac{Q_{S,LTH} - e}{f}$

Demand: $Q_{D,LTH} = g - h * P_{1,LTH} \rightarrow P_{1,LTH} = \frac{g - Q_{D,LTH}}{h}$

$\Big\} P_{1,LTH} = P_{1,LTH}$

$\frac{Q_{S,LTH} - e}{f} = \frac{g - Q_{D,LTH}}{h}$ /Demand and supply are equal in equilibrium,

$Q_{S,LTH}=Q_{D,LTH}=Q$.

$Q_{1,LTH} = \frac{e*h + f*g}{f+h} \rightarrow \boxed{P_{1,LTH} = \frac{g-e}{f+h}}$ /An equilibrium price is formed.

The parameters may vary from country to country, but they are the same in that STH prices are always higher than LTH prices. This is also the case in Hungary, based on research carried out on ingatlan.com and booking.com, which will be presented in detail later. In order to obtain comparable prices, the overhead cost must be deducted from the STH price, as it is paid by the tenant in the long term and by the homeowner in the short term. Thus, the average monthly LTH rent is 276 517 HUF/month, i.e. P_{LTH} = 9 217 HUF/night, while the average price of STH calculated is (33 000 HUF - rent)/night, i.e. approximately P_{LTH} = 30 000 HUF/night. So the main conclusion of the basic model is that the STH price exceeds the LTH price: $\boxed{P_{STH} > P_{LTH}}$.

Airbnb enters the STH market, there is passage between markets (θ)

Short-Term Housing rental market:

Supply: $Q_S = a + b * P_{2,STH} \rightarrow P_{2,STH} = \frac{Q_S - a}{b}$

Demand: $Q_D = c - d * P_{2,STH} \rightarrow P_{2,STH} = \frac{c - Q_D}{d}$

$\Big\} P_{2,STH} = P_{2,STH}$

$\frac{Q_S - a}{b} = \frac{c - Q_D}{d}$ /As there is passage, supply changes.

$\frac{Q_{STH} + \theta * Q_{LTH} - a}{b} = \frac{c - Q_{D,STH}}{d}$

$Q_{2,STH} > Q_{1,STH} \rightarrow \boxed{P_{2,STH} < P_{1,STH}}$ /No equilibrium price is formed. The degree by which the STH price decreases in the second case depends on the passage rate, i.e. the rate of increase of the parameter θ.

Long-Term Housing rental market:

Supply: $Q_S = a + b * P_{2,LTH} \rightarrow P_{2,LTH} = \frac{Q_S - a}{b}$

Demand: $Q_D = c - d * P_{2,LTH} \rightarrow P_{2,LTH} = \frac{c - Q_D}{d}$

$\Big\} P_{2,LTH} = P_{2,LTH}$

$\frac{Q_S - a}{b} = \frac{c - Q_D}{d}$ /As there is passage, supply changes.

$\frac{Q_{LTH} - \theta * Q_{LTH} - a}{b} = \frac{c - Q_{D,LTH}}{d}$

$Q_{2,LTH} < Q_{1,LTH} \rightarrow \boxed{P_{2,LTH} > P_{1,LTH}}$ /No equilibrium price is formed. The degree by which the LTH price increases in the second case depends on the passage rate, i.e. the rate of increase of the parameter θ.

Adaptation lasts (i.e. θ increases) until the price in the short-term housing rental market is equal to the price in the long-term housing rental market, i.e. until the ratio of supply that switches from the long-term housing rental market to the short-term housing rental market is such that $P_{2,STH} = P_{2,LTH}$.

The damage to the interests of the two interest groups already mentioned in the study can be clearly seen from the model. Falling prices in the short-term housing rental market adversely affect hotels and reduce their revenues. As for the increase in the long-term housing rental market price. it means an additional cost for those sections of society who want to live in a sublease for a longer period of time. The set of these people is typically a group of students, young career starters, but anyone who cannot afford to buy their own property, i.e. vulnerable social groups, can be involved.

Due to the low proportion of houses advertised on Airbnb, the prices of the two markets in Hungary did not converge to a large extent. In addition, of course, the short-term housing rental market price is affected by many other factors than those included in the model, so – similarly to the long-term housing rental market – the price growth trend of recent years can be observed in the short-term housing market. Regardless of this, we believe that in order to avoid the blurring of the two markets, it is necessary to regulate the short-term housing rental market in Hungary, especially in Budapest.

4.2. Spatial model in the housing market

In the previous chapter, we reviewed the relationship between market prices in the short- and long-term housing rental market within a microeconomic framework. In the following model, we try to extend these results by adding new variables to the model. The purpose of the model building is to examine the spread and clustering of Airbnb houses. The model tries to represent Budapest, so the assumptions are, as far as possible, adjusted to the Budapest environment. During the construction of the model, we used the following assumptions:

1. The homeowner rents out his apartment at either the STH market or the LTH market. The homeowner assumes that the supply and demand conditions observed at the previous date will continue to exist at the next date. ($E(Q_S^t) = Q_S^{t-1}$ és $E(Q_D^t) = Q_D^{t-1}$) Conscious of the expected demand and supply, the consumer calculates the expected prices for the next year in the STH and LTH market.

2. The homeowner has a utility function in both the STH market and the LTH market and is always active in the market where its utility function is higher. Based on the utility function, homeowners determine the aggregate supply of the market and thus the price for the next period, which may differ from expectations.

3. Transition between the STH and LTH markets is only possible with transaction costs (F_{STH}, F_{LTH}). The transaction cost of the homeowner is higher when entering the STH market than when entering the LTH market ($F_{STH}>F_{LTH}$). This is because at the beginning of the simulation, all homeowners have their homes rented for long-term, and due to Airbnb's lower profile and initial non-regulation, the homeowner assigns a higher cost to moving here.

4. The average consumer is rational, but individual consumers may misjudge their expected utility in the STH and LTH market. Thus, a random variable (ε) appears in the function of each consumer, following a standard normal distribution (N (0,1)).

Under the following conditions, the prices and revenues of the two housing rental markets are not necessarily equal in equilibrium, which is typical of short-term and long-term housing rental in Budapest (Torontáli 2015). In the model, prices in the STH market are denoted by $\hat{p}$, while prices in the LTH market are denoted by p. The essence of the spatial model is that the location of each apartment determines their profit and the decision of the homeowners to operate in the STH or LTH market:

1. There are a total of 200 flats on the market, of which 100 flats are located in 10 inner districts and 100 flats are located in 10 outer districts. There are a total of 10 apartments in each district and each homeowner has one apartment.

2. The inner districts are located near tourist destinations, while the outer districts are further away from them. For this reason, the demand for flats in outer districts is lower at certain prices in both the STH and the LTH markets ($c^2 < c^1$, and $d^2 > d^1$) so the prices formed here ($p^2, \hat{p}^2$) are lower than the prices in the inner districts ($p^1, \hat{p}^1$).

3. If someone in his district enters the STH market, the profit function of the other STH homeowners will increase. The underlying logic is that if the neighbour is already active in the STH market, aversion to it will decrease for the homeowner, and more adjoining homes may increase prices. Furthermore, if more apartments switch to STH market activity, this reduces the chances that other residents will be able to take effective action against them. In the outer districts, the neighbour effect (α^2) is weaker than in the inner districts (α^1). This is because there are more family houses in the outer districts where the neighbourhood effect is less felt than in a condominium.

At the starting point, therefore, an inner district houseowner is faced with the following two utility functions:

$$u^1_{STH} = \hat{p}^1_{STH} + k * \varepsilon(0,1) + n * \alpha^1 - F_{STH}$$

$$u^1_{LTH} = p^1_{LTH} + k * \varepsilon(0,1)$$

where $\hat{p}^1_{STH}$ and p^1_{LTH} are the prices in the STH and LTH markets, ε is the random term, *k* is a corresponding constant, *n* is the number of STH homeowners in the district, and F_{RTL} is the cost of switching from the LTH market to the STH market. Thus, a homeowner operates in the LTH market as long as $u^1_{LTH} > u^1_{STH}$ exists in each decision situation. If the inner district houseowner is operating in the STH market, it will face the following two utility functions on the next period:

$$\hat{u}^1_{STH} = \hat{p}^1_{STH} + k * \varepsilon(0,1) + n * \alpha^1$$

$$\hat{u}^1_{LTH} = p^1_{LTH} + k * \varepsilon(0,1) - F_{LTH}$$

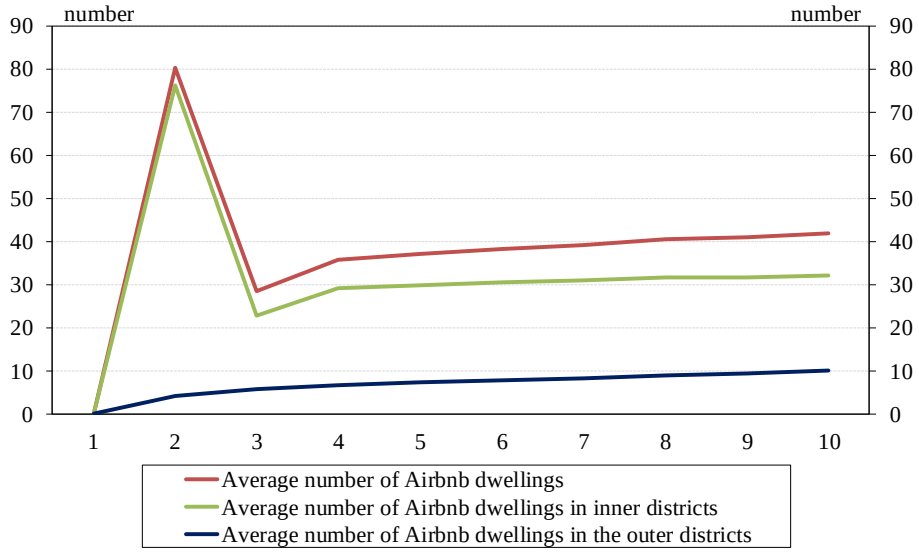
The homeowner operates in the STH market as long as $\hat{u}^1_{STH} > \hat{u}^1_{LTH}$ exists in each decision situation. The decision function of homeowners living in the outer district is similar, only calculated at the given external prices ($\hat{p}^2_{STH}$, and p^2_{LTH}) (see Annex A.1).

At the starting point of our model, each homeowner operates in the LTH market. Assuming supply and demand from period 0, all homeowners calculate their

utility function in period 1, and those homeowners whose utility in the STH market exceeds that in the LTH market will operate in the STH market in the next period. In period 2, assuming supply and demand from period 1, all homeowners determine their utility function and choose to operate in the STH or LTH market. During one run of the model, we assume a total of 1000 periods, i.e., one homeowner has a total of 1000 decision points when deciding whether to rent his home in the STH or LTH market. A total of 50 runs of the model were used and the averages of these runs were analysed in order to filter out and fritter away any outliers for each run.

Examining the average of the 50 runs and the individual elements of the runs, it can be basically concluded that at the very beginning of the simulation, the number of dwellings rented in the STH market follows large jumps from one period to the next. This is because homeowners include the market price determined by supply and demand at the previous period in their utility function, so a search for equilibrium takes place in the first few decision points. Due to the non-equilibrium distribution (STH market: 0 flats; LTH market: 200 flats), the expected and actual market prices of STH and LTH fall far apart (see Figure 2). Furthermore, it can also be observed that firstly there is a greater need for the establishment of Airbnb apartments in the inner districts, where due to higher demand, the homeowners may achieve a higher market price. However, after the initial search for equilibrium, the market becomes stable, as after the tenth decision point there is an average of 41.94 apartments operating in the STH market, which increases to 55.1 during a slow rise after the hundredth decision point and to 61.94 after the thousandth decision point. After the initial search for equilibrium, the market processes are dominated only by the neighbour effect and the random term, because without these the equation of the model can be solved (for deduction, see Annex A.3).

Figure 2 The average number of Airbnb homes formed after 50 runs in the first 10 decision points



Source: Own construction

Analysing the results of the simulation, the effect of the clustering can be well observed, the investigation of which was our goal. If we compare the distribution of dwellings at the early decision points with those observed at later points, we can observe the possible existence and speed of clustering (Table 2).

Increasing the number of decision points, the concentration of flats of the STH market can be observed in the inner districts, because running the simulation fifty times, after the 10th decision point, the inner district with the largest STH market had on average 8.46 flats, and after the 1000th decision point all homeowners (10) were active in the STH market. A similar trend took place in the outer districts, as the value of this indicator increased from 2.86 to 8.14. At the same time, districts where initially fewer flats were in the STH market were gradually pushed out of the market, at the 1000th decision point, short-term housing rental in the three inner districts with the smallest STH market practically ceased. By performing the simulation for more decision points, the densification continues and some parts of both the inner and outer districts have almost solely apartments operating in the STH or LTH market. That is, in the presence of a neighbour effect, clustering also occurs in homogeneous districts.

Table 2 After decision points 10, 100 and 1000, the average number of homeowners in the SHT market in each district, in descending order by district

	Inner districts			Outer districts		
	10.	100.	1000.	10.	100.	1000.
1	8.46	9.96	10	2.86	5.74	8.14
2	6.26	8.62	9.84	1.92	3.6	5.26
3	4.92	6.26	9.12	1.52	2.34	2.7
4	3.8	4.04	5.12	1.32	1.78	1.98
5	3.1	3.2	2.84	0.88	1.3	1.32
6	2.36	2.32	1.26	0.5	0.8	0.84
7	1.52	1.44	0.52	0.2	0.52	0.64
8	1.14	1.08	0.14	0.12	0.18	0.2
9	0.64	0.62	0.06	0	0.02	0.02
10	0.16	0.16	0	0	0	0

Source: Own construction

In Budapest, due to the different transport and tourism characteristics of the individual districts, the initial density points (e.g.: VI, VII Districts) are given, but in the case of the existence of the neighbour effect, the model predicts the continuous strengthening of the STH market here. Thus, in the absence of regulatory intervention, areas will emerge in the city where long-term housing rental will be completely eliminated due to the crowding-out effect of short-term housing rental. In the presence of a neighbour effect, more and more houseowners are switching to short-term housing rental, which is leading to an increase in tourists and noise in individual housing units. This can force

residents living there to move to other districts. They find a buyer for their flats due to the strengthening of the STH market and with their relocation they only promote that the proportion of STH flats in the housing stock of the given district increases even more, thus the district becoming a party district (Szabó 2016). Thus, the regulator should definitely take action if they want to avoid the formation of a party district and the crowding out of the residents from the inner quarters.

5. Regulatory proposals

When designing the regulation, we took into account and examined several aspects: 1. the issue of taxation and legality; 2. its impact on house prices; 3. downtown residential areas becoming party districts.

First of all, we formulate our views on the issue of taxation and legality. The most important aspect in this matter from our point of view is the legalization of the apartments advertised and rented out on Airbnb, and thus the realization of tax revenue. We have listed several international examples where Airbnb has worked with various cities and Member States[8] and collects the tax itself from advertisers on its site and then forwards it to the authorities. This would be a favourable solution for Hungary/Budapest, as it would also reduce the costs of tax collection, in addition to receiving tax revenues. All this could be solved in return so that decision-makers do not make it impossible for Airbnb to operate, legalize its existence in the country/city.

In addition, we believe that ensuring a level playing field in the short-term housing rental market is an important issue in this area. We consider it a legitimate criticism of the already legally and regulated types of accommodation (hotels, apartments, hostels, boarding houses, etc.) that the lack of regulation upsets the competitive balance and provides an undeserved competitive advantage for homeowners advertising on Airbnb. Overall, we believe that the Hungarian/Budapest regulations should seek that an apartment advertised on Airbnb meet the same conditions as an already legally operating apartment and be subject to the same tax liability.

As for the impact on house prices, we also believe that the Hungarian/Budapest market is ripe for regulation. This is illustrated by Table 3, in which we attempted to illustrate our observations under pre-coronavirus market conditions. We have to add to the presentation of the table that in contrast to Airbnb (where the average price appeared immediately after the filtered search for Budapest), we had to calculate these average values manually for booking.com and ingatlan.com. After filtered search, booking.com displayed five different price ranges, based on which we calculated a weighted average using the arithmetic mean of the class and the number of observations in the class.

In the case of ingatlan.com, no such inter-class frequency was available either. There we obtained the results manually, calculating the inter-class frequency by price (manually searching from class-to-class) and then calculating the weighted average. In the case of ingatlan.com data, only the downtown (V, VI, VII, VIII, and IX) districts were taken into account, so we got 5585 results. The need for regulation is also

[8] Available at Airbnb's website: https://www.airbnb.hu/help/article/653/in-what-areas-is-occupancy-tax-collection-and-remittance-by-airbnb-available

supported by the fact that the number of active apartments for rent advertised on the Airbnb website has already exceeded this number, which meant 7457 active apartments for rent in Budapest in 2017, which were advertised on the website by 4266 different individuals (Airdna 2017).[9] Of the 4,266 individuals, 1,311 advertise more than one apartment on the Airbnb website (Airdna 2017), with our regulations we also want to restrict apartments purchased primarily for investment purposes.

Table 3 Price comparison calculated on the basis of the data of the most popular websites dealing with various short-term and long-term housing rental in Budapest

Starting date	Period of time	Booking.com	Airbnb.hu	Ingatlan.com
July 15, 2017.	1 day	HUF 39,175	HUF 28,404	HUF 10,700
	1 week	HUF 40,029	HUF 25,866	HUF 10,700
October 12, 2017.	1 day	HUF 29,523	HUF 20,604	HUF 10,700
	1 week	HUF 28,480	HUF 16,847	HUF 10,700
January 1, 2018.	1 day	HUF 30,331	HUF 21,774	HUF 10,700
	1 week	HUF 28,290	HUF 17,027	HUF 10,700
April 12, 2018.	1 day	HUF 32,867	HUF 23,216	HUF 10,700
	1 week	HUF 31,080	HUF 17,722	HUF 10,700

Note: The data was downloaded from the websites of the respective companies. The average prices were calculated from the prices on the websites between 16:00 and 16:30 on 09/05/2017. The estimated value of overhead and common costs per day was added to the values of ingatlan.com for comparability. Some of the offers on booking.com also include the provision of breakfast (possibly other meals), they have not been treated due to the heterogeneity of the offers and the lack of aggregated data.

We based our restriction proposal on maximizing the daily number of short-term (less than 30 days) housing rentals per year which is common in international practice. We would like to achieve that the transition shown in the model between the short-term housing rental market and the long-term housing rental market is stopped and then reversed. By definition, this affects homeowners with investment purposes, as they can choose between short-term home rentals and long-term home rentals. By doing so, we are consciously not regulating the rentals of homeowners who want to rent out their own home used for living for a short period of time when they are not at home, as this could mean a favourable additional income for them. This is because their activities have only a minimal effect on changes in market prices, while the choice of investment homeowners is a determining factor in the development of prices in the two markets. The exact number of days in which we maximized short-term housing rentals within

[9] 9/5/2017 6:15 PM as available.

one year was determined based on the microeconomic model. As already mentioned, the aim of the regulation is to move investment homeowners back from the short-term housing rental market to the long-term housing rental market. This is the case if their attainable income from long-term housing rentals is at least equal to, but also exceeds, the attainable income from short-term housing rentals. For this, we use the data from the various websites. Both the one-day and the one-week data are important, we have calculated their average, as it is not possible to predict exactly for how many days the owner can rent out their apartment. We assume that Airbnb apartments would reach 90% occupancy in the summer even in the event of the regulation, as this is the main tourist season, the daily amounts attainable are higher, so homeowners' preference also lie in maximizing summer rental days. For this reason, the calculation of the limit was based on the average daily price experienced in the summer for the first 81 rented days, and then on the average price experienced for the rest of the year in the case of the remaining days until the restriction limit. As long-term housing rental is in practice typically for one or more years, we calculated a uniform daily price for them, regardless of the season. $365 * 10\,700 = 81 * 27\,000 + (t - 81) * 19\,000$, where t is the limit of the days that can be rented t=171.45, so based on 2017 data, in the case of a limit of 172 days, it is irrelevant to homeowners with investment purposes to provide supply in the long-term or in the short-term housing rental market.

As we believe that on the one hand, the prices of 2017 have already been affected by Airbnb, and since 2017 they have increased in Budapest until the appearance of the corona virus, so the strictest possible regulation is expedient for the future. It also lays the groundwork for strict regulation to ensure that homeowners actually return to the long-term housing rental market. In view of all this, we recommend setting the limit at 120 days a year. The weak point of the restriction set in days is the inelasticity to the changes in rents. It is precisely for this reason that we have chosen the stricter limit, as we consider the flexible regulation indexed to rents to be unfeasible, we believe that it would lead to dissatisfaction and uncertainty, thus jeopardizing the efficiency of housing markets.

Lastly, we are formulating a regulatory proposal due to the transformation of downtown districts into party districts and the consequent crowding out of residents. In our spatial simulation, we pointed out that the clustering of Airbnb dwellings is continuous if we assume that the neighbourhood effect is present and positive. The assumption of the existence and positive nature of this effect is well-founded, as homeowners, if faced with the operation of short-term housing rentals, find it easier to switch from long-term housing to Airbnb. Furthermore, with the formation of larger blocks, homeowners are already more protected from other owners making it impossible to operate. The previously proposed 120-day annual limit will in any case reduce the formation of clusters, as it pushes those interested in investment-oriented short-term housing rentals to the background and sharing oriented home renters would come to the forefront.

As a result of the regulation, even in extreme cases in a condominium, only a maximum of 1/3 of the flats could operate as Airbnb flats per year on average, which reduces the magnitude of the crowding-out effect. Furthermore, as Airbnb apartment operators are also residents, it is in their best interest that the noise and garbage levels in the condominium do not increase significantly. Here, it can also be important to

expand regulatory elements, drawing on international examples: maximizing the number of guests that can be accommodated and the mandatory designation of a person living near the rented apartment, even a neighbour, to whom a complaint can be made. Thus, with the previously formulated regulation – possibly with the introduction of a maximum number of people that can be accommodated and a mandatory appointment of a person – the formation of party districts could be avoided and the displacement of homeowners from their property would stop.

6. Conclusion

In the study, we first introduced the concept of the sharing economy as well as the operation of Airbnb. Subsequently, we reviewed the international (United States and European Union) and Hungarian regulatory examples related to short-term housing rentals. We then used two models to examine the prices observed in the short- and long-term housing rental market and the location of dwellings in the short-term housing rental market. Finally, based on the results of the model, we formulated regulatory advice that could reduce the negative externalities caused by Airbnb.

Our first main hypothesis was that if an apartment can only be used for Airbnb for a certain period of time in a year, it has a significant effect on market processes. In the first microeconomic model, we pointed out that with the appearance of Airbnb, rental prices may increase in the long-term housing market. θ ratio of homeowners transition from the long-term housing rental market to the short-term housing rental market, as a result of which an equilibrium price is formed in the two markets. However, by maximizing the number of days available for rent, different prices can be achieved in the long- and short-term market, as well as a reduction in short-term housing rental with investment purposes. Thus, our first hypothesis has been proven, maximizing the number of days available to rent can have a significant impact on the price dynamics of the short- and long-term housing rental market.

Our second hypothesis is that in the long run, the location of Airbnb flats will become denser, so the inhabitants of some parts of the districts may be completely displaced, and the given areas may become party districts. This can be an important issue because the living conditions of local residents can become impossible due to the party districts, which can lead to the introduction of regulations that take into account the interests of local residents. We examined this statement with a spatial model, where the homeowner decided to operate in the market of short-term or long-term housing rental by maximizing its utility function. The model was run 50 times, with one homeowner having 1,000 decision points per run. Based on the length of the run and the size of the number of runs, we found that, with the present parameters, Airbnb dwellings are continuously becoming denser in some districts over time. This points out that the process of Airbnb homes becoming denser cannot be avoided neither in a consolidating, shrinking, or fast-growing market, if the value of the neighbourhood effect is positive. This confirms our hypothesis, in the future the development of party districts and the displacement of local residents from the inner districts may continue in Budapest.

In the last chapter, we tried to provide a framework for regulating the short-term housing market in Budapest. We drew ideas from international examples to solve

taxation and legality. In our view, an agreement with Airbnb could significantly increase tax revenues and reduce the number of non-paying Airbnb-ers. Furthermore, we consider it important that a similar set of rules be established for Airbnb apartments and smaller apartments so that the conditions of the competitive market can prevail. In our second proposal, we maximized the rentability of an apartment in the short-term housing rental market in 120 days. In line with our model, this can result in the investment-oriented homeowners being crowded out of the Airbnb market and in a reduction in the growth rate of rental prices. This proposal can also help to eliminate the risk of party districts forming in Budapest and to cease the displacement of local residents.

It is important to note that the following measures, while eliminating the negative externalities arising from the operation of Airbnb and strengthening the sharing nature (positive externalities) in Budapest, reduce the magnitude of the other two positive externalities. As a result of the regulation, a decreasing supply and an increasing price would develop in the short-term housing rental market, and as a result, fewer foreigners would be expected to come to Hungary. Furthermore, the annual limit of 120 days would reduce the income of homeowners. Thus, our regulatory framework provides a solution to eliminate negative externalities at a price that would reduce the benefits of Airbnb in the meantime. Thus, it is definitely worthwhile to examine the costs of the possible restrictions in a later analysis.

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Annex

Annex A.1.: The homeowner'a utility function in the outer districts

If the landlord was active in the LTH market in the previous period:

$$u^2_{\mathrm{STH}} = \hat{\mathrm{p}}^2_{\mathrm{STH}} + \mathrm{k} * \varepsilon(0,1) + \mathrm{n} * \alpha^2 - F_{\mathrm{STH}}$$

$$u^2_{\mathrm{LTH}} = p^2_{\mathrm{LTH}} + \mathrm{k} * \varepsilon(0,1)$$

The homeowner is active in the LTH market as long as the $u^2_{LTH} > u^2_{STH}$ inequality holds in each period.

If the landlord was active in the STH market in the previous period:

$$\hat{u}^2_{\mathrm{STH}} = \hat{\mathrm{p}}^2_{\mathrm{STH}} + \mathrm{k} * \varepsilon(0,1) + \mathrm{n} * \alpha^2$$

$$\hat{u}^2_{\mathrm{LTH}} = p^2_{\mathrm{LTH}} + \mathrm{k} * \varepsilon(0,1) - F_{\mathrm{LTH}}$$

The landlord is active in the STH market as long as the inequality $u^2_{\mathrm{STH}} > u^2_{\mathrm{LTH}}$ persists in each period.

Annex A.2.: Parameters used during the simulation

Parameters of demand functions:	c^1	110
	c^2	100
	d^1	4,5
	d^2	6
Additional parameters of the utility function:	k	2
	F_{STH}	20
	F_{LTH}	2
	α^1	1
	α^2	0,5

Annex A.3.: Equilibrium solution of the model without neighbour effect and random effect

The landlord's choice if he/she was active in the LTH market::

$$u_{\mathrm{STH}} = \hat{\mathrm{p}}_{\mathrm{STH}} - F_{\mathrm{STH}}$$

$$u_{\mathrm{LTH}} = p_{\mathrm{LTH}}$$

The landlord's choice if he/she was active in the STH market:

$$u_{\mathrm{STH}} = \hat{\mathrm{p}}_{\mathrm{STH}}$$

$$u_{\mathrm{LTH}} = p_{\mathrm{LTH}} - F_{\mathrm{LTH}}$$

The system will be balanced if it is not worthwhile for any landlord to switch, that is, for each STH homeowner, there is an inequality a $u_{\mathrm{STH}} > u_{\mathrm{LTH}}$, and for LTH homeowners, there is an inequality $u_{\mathrm{LTH}} > u_{\mathrm{STH}}$. That is $\hat{\mathrm{p}}_{\mathrm{STH}} - F_{\mathrm{STH}} > p_{HTL}$ and $\hat{\mathrm{p}}_{\mathrm{STH}} < p_{\mathrm{LTH}} - F_{\mathrm{LTH}}$. The price of $\hat{\mathrm{p}}_{\mathrm{STH}}$ and p_{LTH} depends on the supply of STH in the previous year, which is unchanged in equilibrium (N), so the problem to be solved is:

$$\frac{c-N}{d} - F_{STH} < \frac{c-100+N}{d}$$

$$\frac{c-N}{d} > \frac{c-100+N}{d} - F_{\mathrm{LTH}}$$

Solving the equation with the parameters in Annex A.2, the solution for N is obtained. Because of the transition costs, N will be in equilibrium in an interval, for example, for an inner districts, the solution to the equation is 5<N<54.5. In other words, if the number of dwellings offered on the STH market in the inner districts is within the following range, no one will move to the other market.

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An examination of obesity in terms of eating behavior and self-control

Dalma Krisztik-Pető

Obesity has become a pandemic that has been spreading for decades now. The treatment of diseases caused by obesity places a burden on the economy, with health care expenditures and even with indirect costs. Eating behaviour and self-control are considered to be the most important factors regarding the treatment and prevention of obesity. This study is looking for the answer to what level of self-control young consumers have, and how this affects their eating behavior and, through it, their body weight. Based on the results, it is concluded that the respondents do not necessarily judge their weight realistically. Self-control has a prominent role to play in preventing obesity. According to this research, individuals with weak self-control are most characterized by emotional eating and eating for external influences, while those with strong self-control are characterized by restrained eating.

Keywords: self-control, eating behavior, obesity

1. Introduction

Obesity has become a pandemic that has been spreading for decades now (Rurik et al. 2016). More and more adults and children are overweight, and their rate is gradually increasing (OECD 2017a). Among the countries of the European Union, Hungary ranks first in terms of the obesity rate per adult population (61.6%) (OECD 2017b). This is mainly due to a sedentary lifestyle and poor eating habits. Many diseases can be a source of malnutrition and consequent obesity. The treatment of these diseases also places a burden on the economy, accounting for 5–7% of health care expenditures, but this is even associated with indirect costs (Finkelstein et al. 2005).

Nutrition affects our entire life, from the beginning of our childhood. Our eating habits develop very early on and affect our health. Improper nutrition can affect our entire life or even shorten it. Therefore, it is important to pay attention to the development of appropriate eating habits already in childhood (Huszka–Dernóczy, 2015).

A healthy diet, paying special attention to the consumption of fruits and vegetables, helps to get the right amount and quality of nutrients into our body, along with filling it with vitamins. However, unfortunately, the diet of all age groups differs from the recommended: they consume less vegetables and fruits, but more energy-rich, poor-quality foods (Black et al. 2017).

One of the consequences of malnutrition is obesity, which is becoming more common with advancing age. 20.3% of Hungarian men aged 15–17 are overweight or obese, compared to 46.2% in the 18–34 age group. The situation is similar for women: 9.9% of 15–17-year-olds and 32.3% of 18–34-year-olds are overweight or obese (KSH 2020).

The first signs of many chronic diseases (such as cardiovascular disease, diabetes, and obesity) can be detected as early as childhood (Black et al. 2017). In

addition, psychological illnesses such as depression are also associated with obesity, which means an even worse quality of life for the person (Vazquez–Torres-Iglesias 2012). According to a study involving children and young people between the ages of 2 and 19, obesity that begins at a young age is much more likely to cause fatal illness than if obesity develops only in adulthood. In this case, the chances of type 2 diabetes, hypertension, and cardiovascular disease also increase significantly (Park et al. 2012). However, not only long-term but also short-term consequences can be expected, as pathological obesity already causes health problems in the short term (Reilly–Kelly 2011).

It is difficult to study health as a value in economics because it is a typical goods that has a definite price or market value. In the same way, it is not possible to quantify the number of healthy years spent and the extra years of life (Lippai 2012).

The level of health care expenditures is increasing year by year. Examining the data on domestic health expenditure, we can see that households are spending more and more money on it in Hungary as well, especially for medicines, medical aids and other medical goods (KSH 2017).

The study of healthy eating for the young age group is of paramount importance as they will be the workers and consumers of the future. Although they do not yet have their own earnings, they make their own decisions about their daily diet and some of them are old enough to even cook for themselves. This study is looking for the answer to what level of self-control young consumers have, and how this affects their eating behavior and, through it, their body weight.

2. Obesity, an economical issue

Obesity is an increasingly serious problem for both society and the economy. More and more adults and children are overweight, and their rate is gradually increasing (OECD 2017a). Comparing current data with those of two decades earlier, it can be shown that the number of overweight children has doubled, while the number of young people in obese adolescence has tripled (Vazquez–Torres 2012). Among the countries of the European Union, Hungary ranks first in terms of the obesity rate per adult population (OECD 2017b). This is due to the lack of exercise and the fatty, low-fiber dishes of Hungarian cuisine. Vegetable and fruit consumption, which is the basis of a healthy lifestyle, is also very low in Hungary (Pfau et al. 2018).

The factors affecting a person's health can be divided into two groups. The uncontrollable risk factors include innate genetic attributes, characteristics gained over the years, gender and age. The factor we can control is lifestyle. Health is determined in the highest proportion by lifestyle (43%), followed by genetic factors (27%), environmental effects (19%), and healthcare (11%) (Lalonde 1974). Among lifestyle factors, nutrition is crucial from the perspective of our health. Our eating habits develop as early as our childhood, and they influence our later state of health. Malnutrition may affect our whole life and even shorten it. Therefore, it is important to pay attention to the evolvement of proper eating habits from children's early age (Huszka et al. 2015).

Eating is largely due to our consumption decisions. Healthy eating actually means choosing the right foods, so it is an area of examination relevant to consumer behavior. A consumer with healthy eating habits pays special attention to the consumption of vegetables and fruits and follows the recommendations for healthy

eating rates in their diet. However, unfortunately, the diet of all age groups differs from that recommended: they consume few vegetables and fruits, but many energy-rich, poor-quality foods (Black et al. 2017). Differences from healthy eating behavior often stem from a lack of awareness, as for many, a healthy lifestyle is synonymous with dieting, and it is believed that the complete elimination of sugar from the diet is healthy (Gál et al. 2017).

2.1. Economic consequences of obesity

Treatment of obesity-related diseases accounts for 5–7% of health care expenditures, but this is even associated with indirect costs, such as lost work or expenditures outside the health care system (Finkelstein et al. 2005). Examining the data on domestic health expenditures, we can see that households are spending more and more money on it in Hungary as well, especially for medicine, medical aids and other medical goods (KSH 2017). 52% of the population (according to their own self-report) suffer from some chronic disease (KSH 2015). According to a study conducted in 2010, health is the most important value for the Hungarian population, but during the implementation it is already lower in the order of importance, as in this case it was only in the 14th place (Hofmeister-Tóth 2016). In Hungary, health awareness is more common among those with higher education and income, those living in big cities, and women. However, these differences become smaller the younger the person is (Malota et al. 2019).

The costs associated with obesity can be divided into three categories. Direct costs include patient care, rehabilitation, health care, emergency care, administration, research. and education related to obesity (Sonntag et al. 2015). This includes the costs of treating comorbidities as well as non-medical expenses such as diet and sports equipment (Iski–Rurik 2014).

For the overweight, there are also indirect costs associated with psychosocial problems, such as school bullying in childhood, and poorer school performance, which can also lead to lower productivity in adulthood. In addition, parents are more likely to be absent from work due to more common illnesses in obese children (Sonntag et al. 2016). An additional indirect cost is the cost of morbidity, which results from incapacity for work due to being overweight and related diseases, reduced work capacity, lower productivity, and their frequency is 17% higher than in the case of people of normal weight (Tóth–Nagy 2009). Mortality costs cover lost future income from early death (Iski–Rurik 2014).

The intangible costs incurred at the individual level are difficult to quantify, as they approach the harms of obesity from a spiritual point of view (Iski–Rurik 2014).

The cost of obesity-related illnesses in the course of public funding (in 2012) was HUF 207 billion, to which the cost incurred at the individual level is added, which amounted to nearly HUF 22 billion. This amount corresponds to 0.73% of domestic GDP. The real costs may be even higher than this, with some estimates accounting for up to 15-18% of total health expenditure and at least 1% of GDP (Iski–Rurik 2014).

The health systems of today's societies focus primarily on the treatment of diseases, with healing and restoring health as their main task (Lippai 2012). Yet it can be said that prevention could do a great deal at both social and individual levels, not to mention improving an individual's quality of life, which is priceless.

3. Eating behavior

Eating behaviour is considered to be the most important factor regarding the treatment and prevention of obesity and related illnesses (Danielsen et al. 2013). Before examining eating behavior, it is very important to note that food is not a medication, so it is not suitable for self-medication (Lockwood 2007). Individual foods are not healthy or unhealthy. To achieve their positive or negative effects, we need to consume them regularly. We will not experience an immediate effect, as with medicine. The same is true for obesity. There are no "fattening" or fat-burning foods, weight gain is the result of a very simple formula: if you put more calories into your body than you burn, you will gain weight in the long term (Dovey 2010).

Examining eating behavior includes motivation to choose food, eating practices, diet, and related problems such as obesity and eating disorders. It aims to help treat and prevent nutrition-related obesity and disease (LaCaille 2013).

3.1. Types of eating behavior

Numerous types of different eating behavior (also known as eating styles) are distinguished in the literature, of which the following three categories – perhaps the most widely examined – are interesting from our perspective: emotional eating, restrained eating, and disinhibition (Herman–Mack 1975, Herman–Polivy 1975, Stunkard–Messick 1985; van Strien et al. 1986). The characteristics of these three eating behaviors are presented below. As a preface, it is important to note that these different eating behaviors (eating styles) represent specific behavior that is not exclusive, i.e., a person may engage in multiple eating behaviors and have them often interacting with each other (see emotions and cognitive control).

3.1.1. Eating under the influence of emotions

Eating not only satisfies our physiological needs but often also affects our emotions, i.e. eating a single meal can also improve our mood. According to psychosomatic theory, those who eat triggered by emotions (fear, anger, anxiety) do not recognise this stimulus, and therefore they eat too many calories. They are called emotional eaters (Kaplan–Kaplan 1957). Emotional eaters have an additional component according to food (Dovey 2010). 75% of overweight people are struggling with this problem. Emotional eaters often choose food high in fat and sugar, and therefore tend to have higher risk of diabetes and heart disease (Frayn–Knäuper 2018). Obese emotional eaters often reduce anxiety by eating and become more obese as a result (Kaplan–Kaplan 1957). Special types of eating under the influence of emotions are binge eating under stress or depression and eating at night. These "episodes" occur regularly in the more stressful stages of life (Mendelson et al. 1961) and often occur in secret (Loro and Orleans 1981). Obsessive-compulsive disorder can also affect three-quarters of obese individuals and is more common among women (Ganley 1989).

3.1.2. Restrained /controlled eating

According to the restrained eating theory of Herman and Polivy (1975), normal eaters rely on their physiological needs only during nutrition, i.e. they eat only as much as they need to cover their energy use. They only eat when they are hungry and only eat until they feel it has been enough. Nothing can shock them out of this. However, controlled eating should not simply be seen as a diet (Heaven et al. 2001). The theory of restraint says that during diet the individual consciously restrains food consumption to reduce or maintain weight, which leads to metabolic processes slowing down and reducing the feeling of hunger. However, as soon as self-control decreases (for example, as a result of alcohol or negative emotions), cognitive restraint decreases and eating behaviour turns into the opposite direction, leading to excessive food intake. Furthermore, as a result of restrained eating, the individual may lose control over the feeling of hunger and the feeling of satiety, which leads to eating based on emotional or external effects (Herman–Polivy 1975).

Westenhoefer et al. (2013) found that this phenomenon may also occur due to the existence of two types of controlled eating: rigid and flexible. Strictly controlled eating is characterized by a kind of "all or nothing" eating behavior, i.e., strict in terms of diet, it does not allow fluctuations. Surprisingly, however, this type is characterized by undulation, i.e., often the strict period is followed by a period that allows the consumption of fatter and fattening foods. Flexible controlled eating, on the other hand, is a much more successful way to diet or maintain weight, as in this case, fatty, sugary foods are not prohibited, they can only be consumed in smaller amounts. Strict controlled eating is much more prone to various eating disorders such as anorexia or bulimia due to oscillations, while flexible controlled eating suggests high self-control and results in successful weight management. Unsurprisingly, strict controlled eating behavior correlates with higher BMI, while flexible controlled eating behavior may be associated with lower BMI (Westenhoefer et al. 2013).

3.1.3. Uncontrolled eating

Disinhibition, i.e. the loss of inhibition indicates an eating behavior where the individual loses control for some reason, or is disturbed by something, so they eat more food. One classic example is when we eat a lot more snacks than we really need or drink a liter of soft drinks while watching a movie. This is because the action (in this case, watching the film) distracts us, so we do not realize how much we eat (Dovey 2010).

Impulsivity, a form of behavior in which an individual does not consider the weight and consequences of his or her actions is an important factor in uncontrolled eating. Impulsive people are less likely to have eating habits that are necessary for a healthy diet, such as eating meals, eating at regular intervals, and are more likely to reach for high-fat meals in such cases (Lyke–Spinella 2004).

Eating externally is a special form of eating behavior associated with loss of control that results from a response to food-related (external - smell and internal - hunger) signals (Heaven et al. 2001). External theory has a similar position, claiming that the external environment determines eating behaviour and the vision and smell of food generate an overly strong reaction in overweight people (Schachter–Rodin 1974).

3.2. Measuring eating behavior

Eating behaviors and attitudes have been the subject of numerous studies, and several measurement methods have been developed to investigate it. Garner and Garfinkel's (1979) Eating attitude test (EAT) can be used to examine mainly eating disorders. With the Herman and Polivy (1980) Restriction Scale, we can measure how consciously an individual limits food intake to limit their weight. This questionnaire provided the basis for the Three Factor Eating Behavior Questionnaire (TFEQ) (Stunkard–Messick 1985) and the Dutch Eating Behavior Questionnaire (DEBQ) (Van Strien et al. 1985). Both examine three eating behaviors: TFEQ distinguishes between uncontrolled eating, cognitive restriction, and emotional eating, and DEBQ distinguishes between restrained eating, emotional eating, and eating for external influences.

Dutch Eating Behavior Questionnaire (DEBQ) is a questionnaire designed to measure eating behavior that was developed in 1986 by van Strien et al. The questionnaire, originally consisting of 46 items, was later reduced to 33 questions, which have since been validated in several countries (including Brazil, China, Spain, France) (Moreira et al. 2017, Wu et al. 2017, Cebolla et al. 2013, Bailly et al. 2012).

The questionnaire examines eating behavior using three subscales. The *external eating* scale examines consumption under the influence of external stimuli associated with food, regardless of an individual's sense of hunger. The *restrained eating* scale measures whether an individual intentionally restrains their food intake to lose weight or prevent being overweight. The third, *emotional eating* scale, examines the effect of emotions (e.g., anger, tension, nervousness) on nutrition (Van Strien et al. 1986).

4. Consumer rationality in relation to nutrition

Classical economic models also assume rational consumers who try to maximize their benefits. This is true of homo sapiens, which satisfies only the means of sustenance, but the motives of a "well-to-do" person's actions are more in the sense of emotion (Székely 2003). The reason for assuming rationality is that this makes economic interactions easier to examine. According to Friedman (1986), if we look at these interactions in an aggregate way, the irrational behavior of each actor does not affect the results, so we may be able to make assumptions about the future (Friedman 1986).

Behavioral economics examines the consumer's characteristic that rationality is often missing in real economic decisions. The reason for this is essentially in the decision process, which consists of many factors such as perception, influence, motivation and preference (McFadden 1999). Consumers often do not choose the optimum because they make mistakes, are uninformed, or do not have self-control for rational decision-making (Mulvaney–Lee 2017). Herbert Simon, who won a Nobel Prize for his theory of limited rationality, says that we do not have to deal with how the actors of the economy should behave, but how they actually act (Simon 1986). The theory of limited rationality does not want to abolish the models of rationality of neoclassicals but rather complement it (Simon 1986, Golovics 2015), since limited rationality also presupposes that people act rationally, but their cognitive and emotional properties influence their decisions (Jones 1999).

In case of nutrition, rational behavior would be the choice of healthy alternatives, but consumers do not always choose them. As we can see from the discussions above, they do not necessarily act irrationally, they only decide on the limits of their cognitive and emotional attributes.

4.1. Intertemporal decisions

Such a limit may be by choosing unhealthy food as the problem of consumer self-control, as unhealthy food is often finer, more desirable, or even cheaper and easier to access. Thus, the benefits of eating unhealthy food are immediately realized by the consumer, while related expenditures (problems) occur only in later years. "Intertemporal situations are often formulated in economic researches as a choice between 'attractive at short-term/ hurtful in long-term' and 'hurtful in short-term/ useful in long-term' alternatives" (Lippai 2008, 6). These decisions are choices that will have an impact in the future (Berns et al. 2007).

For nearly 80 years, economists have used the discounted utility model to examine intertemporal decisions. The model assumes that people value the joy and pain of their decisions in the same way that financial markets value profits and losses, exponentially discounting the value of the outcome depending on how late it occurs in time (Berns et al. 2007). The discounted utility model attempts to model the psychological factors behind intertemporal decisions, where the discount rate is constant (Bölcskei 2009). Ainslie (1975) was the first to question the validity of the discounted utility model. According to him, the discount rate should be exponential. The most accepted model is the hyperbolic discounting model, which explains intertemporal decisions much better in the light of self-control problems (Bölcskei 2009). According to Elster (2001, in Lippai 2008, 55), "consumer self-control can be defined as one of the possible explanatory principles for anomalies in intertemporal consumer decisions relative to the expected (rational) outcome, which is basically two irrational forms of consumer behavior (?) / Heuristics. (?) refers to: myopia and procrastination. This approach also requires correction of the homo oeconomicus human image but leaves its basic axioms unchanged."

To describe the self-control problem explained by the hyperbolic model, Fudenber-Levine (2006) developed the double self-model. The point is that individuals are both forward-thinking planners and short-sighted actors. A planner self seeks to maximize benefits in the long run, while acting in my selfish and short-sighted way. The source of the conflict is the conflicting interest. The planner self, however, seeks to encourage the acting self by using incentives to change the preferences of the acting self, or by setting and controlling rules. For example, in case of dieting, this person checks how much weight they have lost every month. In case of dieting or dieting, it can also be a solution if the planner self does not limit the possibilities of the acting self to a single action but only limits or reduces them (Bölcskei 2009).

Also, the model created to explain self-control problems associated with intertemporal decisions is a model of desire for commitment. The essence of Gul-Pesendorfer's (2001) model is that the individual limits their choices, thus trying to exercise self-control and resist temptation. If one has high self-control, one will choose the alternative that has higher utility in the long run.

The willpower model is also used to model self-control problems related to intertemporal decisions (Ozdenoren et al. 2006). The model is explained by a simple example of cake consumption. Using the discounted utility model, the individual consumes the cake at a steady rate. In reality, however, this often happens when an individual consumes an increasing amount of cake, but this cannot be explained by either the hyperbolic or the double self-model, only the willpower model. This model simultaneously explains present-biased preferences, preference change, need for commitment, and preferences for a growing line of consumption (Bölcskei 2009). According to the model, earlier cognitive exertion has an effect on later consumption as willpower decreased. But it is also conceivable to leave the best to the end, so a negative preference is realized. Also, the individual often tends to link two actions that require self-control, such as quitting smoking and eating. They give up smoking, but in the meantime they allow themselves to be seduced and eat more than they need to. "The consumer exerts their willpower when it has the lowest opportunity cost, that is, when it has a large willpower and before it runs out over time, so the indirect marginal benefit of increased consumption increases over time" (Bölcskei 2009, 1032. o.).

4.2. The relationship between consumer self-control and nutrition

The relationship between nutrition and self-control has also been addressed by a number of researchers, with the main focus on obesity. Looking at the past 50 years, we can see that due to the development of technology, food prices have been falling, while the intensity of exercise has fallen due to more and more sedentary work. Obesity is mainly due to these causes (Lakdawalla–Philipson 2002). Thanks to technology, work has also become more productive, allowing more and more tasks to be performed with less and less intensity and calorie burning, which also promotes obesity (Finkelstein et al. 2005). Although obesity can have a health cause, it can be seen that the main factor influencing being overweight is an individual's personal lifestyle. Consequently, "the self-control variable can play a very important role in the development of a form of behavior where consumers, who are fully aware of the benefits of exercise and the disadvantages of unhealthy eating, still lead unhealthy lifestyles" (Lippai 2008, 77).

According to Stutzer and Frey (2006), the cause of obesity is poor self-control and short-sightedness in the individual. It can be shown that if someone gets rid of more weight, it is easier to control their behavior. The source of the problem is that people come across too many opportunities with low immediate marginal costs but high long-term marginal benefits. Because of their lack of self-control, they turn to these opportunities with short-sightedness. They may be able to resist some temptation, but they have difficulty controlling their decisions because of too many options. This is related to the willpower model mentioned above (Ozdenoren et al. 2006).

Self-control can play a role in several phases of a decision situation. In problem identification, there may be a contradiction between the short and long term when defining future goals. But self-control is also needed to make the right choice when searching for and evaluating information. The consumer needs time to gather information and the lack of time often leads to impulse buying (Lippai 2008).

Examining consumer self-control and examining consumer motivations can help create a preventive health policy that strengthens self-control in consumers about healthy eating. Thus, health care expenditures could be reduced in the future, as well as the burden on taxpayers.

5. Material and methods

In my empirical study, I have examined the level of self-control of young people as well as their eating behavior in Hungary. I hypothesize that those with less self-control are more likely to eat for emotional or external influences, while those with higher levels of self-control are characterized by restrained eating.

To measure self-control, I have used the Tangney et al. (2004) self-control scale, which is based on a psychological method to examine personality traits characteristic of self-control. The self-control scale of Tangney et al. (2004) consists of 36 items. It examines five dimensions of self-control (self-discipline, non-impulsivity, healthy habits, work ethic, and reliability). This self-control scale is widely known and has been adapted in many languages (French: Brevers et al. 2017; Chinese: Unger et al. 2016; German: Bertrams 2009). It was first adapted to Hungarian language by Lippai (2010). The respondent should indicate on a 5-point Likert scale how true the statement is of them. Each statement is inversely coded, so this should be considered in the analysis. Adding the points given to the answers gives the self-control score of the given person.

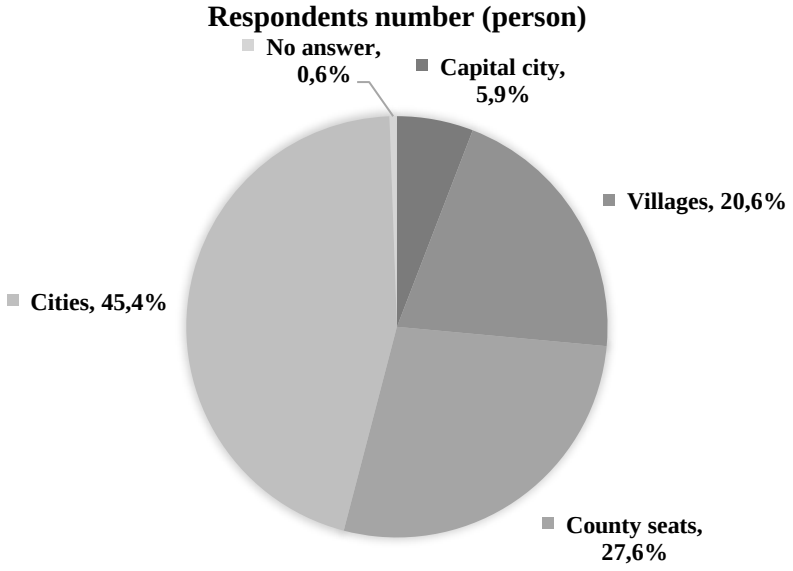
To measure eating behavior, I have used the above-mentioned Dutch Eating Behavior Questionnaire (DEBQ) to measure eating behavior.

The questionnaire survey was preceded by a small sample (30 person) trial survey, thus ensuring that the questions were understandable to everyone. The questionnaire was completed by a total of 529 people, the respondents were young people aged 18 to 23, all of them university students.

The questionnaire was conducted both offline and online. Data collection lasted for 3 months. During this time, more than 700 answers were received. The questionnaire was distributed to as many young people as possible with the help of university lecturers, who helped to distribute the questionnaire among the students. The respondents were screened for 18–23-year-olds. After data cleansing, 529 people remained in my sample.

29.9% of the young people in the sample were men and 70.1% were women. 88.3% of them live in cities and only 12% of them live in a village or municipality (Figure 1.)

Figure 1 Permanent residence of the sample



Source: Own construction

6. Results

To examine the self-control scale, all variables were brought into the same form so that a higher score meant greater self-control everywhere and a lower score meant less self-control. I then examined the correlation of the variables with Cronbach's Alfa. Cronbach's Alpha was 0.833, indicating that the variables were consistent.

The minimum value measured by the self-control scale is 49 and the maximum is 134. The mean of the scores is 81.45 and the standard deviation is 14 (Table 1).

Table 1 Mean and standard deviation of self-control scores

Self-control scores	Respondents number (person)	Minimum score	Maximum score	Mean	St. dev.
	529	49.00	134.00	81.4556	14.00806

Source: Own construction

Three categories were developed from the self-control scale. Values in the +/-1 standard deviation range from the mean were in the middle group, those with a lower score were in the weak self-control group, and those with a higher score were in the strong self-control group. With this grouping, 81 people have weak, 365 people have normal, and 83 people have strong self-control. The distribution of women and men is evenly distributed among each self-control category (Table 2).

Table 2 Distribution of the sample by self-control categories

Self-control categories	Respondents number (person)	Distribution (%)
Weak	81	15.3
Normal	365	69
Strong	83	15.7
Total	**529**	**100**

Source: Own construtions

Furthermore, from the questions of the DEBQ scale, I was able to create factors determined on the basis of the original scale, i.e. emotional eating, eating for external influences, and restrained eating factors with the help of factor analysis. Here, however, it is important to mention that, based on the responses of our respondents, I was only able to create these artificial variables without including some of the statements from the original variables in the factor analysis (Table 3).

We also examined the Cronbach's Alpha value for the scales that make up each factor to see how well the variables correlate. Cronbach's Alpha was 0.953 for the emotional eating scale, 0.895 for the restrained eating scale, and 0.851 for the external effect scale, indicating that the variables are consistent.

Table 3 Results of principal component analysis

DEBQ scale	
KMO	0.931
Bartlett test sig. value	<0.05
Cumulative variance ratio (%)	59.036
Number of factors created (db)	3

Source: Own construtions

The self-control scale was then compared with eating behavior factors (Table 4). Positive values in the table indicate that those in the given self-control group are more affected by the given factor than all respondents in general, while negative values indicate that they are less affected by the given eating factor compared to the average. The greater the deviation from zero, the more significant this effect is. Thus, we can see that in the analysis, in line with our expectations, the eating habits of those with poor self-control are most affected by emotions and external stimuli. In contrast, individuals with strong self-control are not characterized by eating under the influence of either emotions or external influences, while restrain eating characterize only them.

Table 4 Comparison of self-control level categories with eating behavior categories

Self-control categories	**Eating behavior**		
	Emotional eating	Restrain eating	External eating
Weak	**+0.438**	–0.119	**+0.369**
Normal	+0.023	–0.044	+0.005
Strong	–**0.554**	**+0.323**	–**0.401**

Source: Own construtions

Those with moderate self-control also achieved the results we expected. The diet of those in this group is affected by both emotions and external influences, however, these effects do not appear much stronger than the average for either factor.

Based on these results, it can be said that (as has been suspected) individuals with weak self-control are more likely to eat under the influence of emotions or external factors, and individuals with strong self-control easily resist delicious and tasty looking food and are really successful at dieting.

The same relationship was studied between BMI categories and eating behaviour types (Table 5). The results show that eating under the influence of emotions is most characteristic of obese people, as well as the overweight. Moderate eating is most characteristic of the obese. This may be due to the fact that moderate eating can be strict and flexible, which is linked to the success of the diet (Westenhoefer et al. 2013). So obese people can be characterized by moderate eating, because they are constantly trying to diet (but this, as their weight shows, does not work for them).

Table 5 Comparison of BMI categories with eating behaviour types

BMI categories	**Eating behaviour**		
	Emotional eating	Restrain eating	External eating
Skinny	–0.104	–**0.514**	+0.067
Normal weight	–0.050	–0.007	+0.026
Overweight	+0.137	+0.251	–0.174
Obese	**+0.543**	**+0.401**	–0.047
Total	–0.002	–0.002	+0.001

Source: Own construtions

7. Conclusion

Classical economics assume a rational consumer who always weighs the choices and always chooses the most optimal one. In practice, however, this is not the case. An individual's decisions are also influence by their emotions, in our case, when making eating decisions.

When making eating decisions, we are often confronted with the problem of intertemporal bias, especially when it comes to consuming unhealthy foods. The individuals evaluate their current situation and decide on it, they do not take into account the negative effects of their decisions in the future. These decisions can also be influenced by their eating behavior, as they have poor self-control, they tend to consume more food due to emotions or external factors.

In my study, I have sought the answer to the question whether there is a correlation between young people's level of self-control and their eating behavior. To answer this question, I have conducted a questionnaire survey based on the Tangney et al. (2004) self-control scale and the Dutch Eating Behavior Questionnaire (DEBQ). I have created three self-control level categories (weak, moderate, strong), which I have compared with the three categories of eating behavior (emotional eating, restrained eating, and eating under external influence). The results show that individuals with poor self-control are much more likely to consume more food as a result of heightened emotions, and when they see food that is desirable to them, they consume it regardless of whether their body is hungry or needs the extra calories. In contrast, individuals with strong self-control are not characterized by eating under the influence of either emotions or external influences, while restrain eating characterize only them.

The results of a previous study on a smaller sample showed a similar result in the case of weak self-control, but in the case of strong self-control they were found not to be characterized by restrained eating (Pető–Lipták 2020). According to Kuijer et al. (2008), restrained eating can only be associated with poor dietary decisions when coupled with poor self-control.

The results of this study may be useful for obesity prevention campaigns. In my opinion, it would be worthwhile to introduce consumers to the theory of types of eating behaviors, because if they were aware of the effects that affect them personally in their diet, they could easier pay attention to prepare for such situations and practice greater self-control. It would be worthwhile to take an online software-based self-filling test to help everyone find out which types of eating behaviours are most typical of them.

The limitation of this study is the unrepresentative sample, the respondents do not describe the population studied, but it provides a good starting point for the examination of correlations.

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The growth of influencer marketing: A comparison of TikTok and Instagram

Munif Mohammed Al-Zoubi

Social media has changed our day to day life in so many aspects, and especially with COVID-19 forcing people to stay at home, the use of the internet and platforms has increased dramatically. We now use social media for communication, learning, entertainment, and even for work purposes. There has been a significant increase in the number of people on all social media platforms, and this increase in the number of users viewing all sorts of content gave rise to influencers or "leaders of opinion", i.e. experts in certain fields with many followers viewing their content. Influencers in many cases have the ability to affect the decision-making process of their followers, which caused many organizations to turn to them, giving them partnerships and sponsorships in exchange for influencers marketing their products/services. In this study, a comparison is attempted between the two biggest influencer marketing platforms, Tiktok and Instagram, and an attempt is made to give businesses who are thinking of using influencer marketing a better understanding of this phenomenon. The paper also aims to help businesses that already have an influencer marketing strategy in place realize if their current platform is most suitable to their business. This study uses qualitative research, as the data has been gathered through the multiple interviews with different types of businesses, influencers and social media experts.

Keywords: social media, social media marketing, influencer, influencer marketing, Instagram, TikTok.

1. Introduction

We can now do almost anything with a single click: grocery shopping, shopping, studying, traveling, attending concerts, resolving any document issues, and so on. Most companies, whether small businesses or a large governmental agencies, strive to transfer their services online in order to facilitate workflow and improve client interaction.

There are numerous social media platforms available today, each with a unique type of content sharing opportunity and a distinct demographic of followers. The most famous platforms are as follows:

- Facebook: founded by Mark Zuckerberg in 2004, the site is free for members to sign up and predominantly derives its revenue from advertisements. Facebook is currently the platform with the highest number of users worldwide. On Facebook users can create profiles and share their thoughts and information, the information can be quotes about themselves or other subjects, pictures, and news, allowing other users to comment and respond to any of the posts.
- Twitter: the site was created by Jack Dorsey, Noah Glass, and Evan Williams in 2006. It is a "microblogging" website, initially created as a short message service (SMS). Twitter allows users to create accounts and share their ideas

in the form of a 280 character message and can include links to websites, journals, or news pages; these messages are called Tweets. For users to be able to read someone's Tweet they need to follow them on Twitter. Users can follow friends, celebrities, and organizations that have similar academic or personal interests.

- Instagram is a social networking site that allows users to share photos and short videos, the site was acquired by Facebook in 2012. Instagram is one of the most popular applications for mobile users, the app allows users to take photos, edit and add filters to pictures before the user uploads them, and the pictures could be uploaded with a caption to describe the picture, hashtags, or a geotags which allows the user to share the location of the picture. These additions to the picture can help other uses search for these picture via an index. The pictures shared can be viewed by the user's followers, or by the public when tagged using a hashtag or geotag.
- TikTok is growing social media platform that was originally created in China under the name A.me in September of 2016, and was changed to Douyin, and when they expanded overseas it was given the name TikTok. Tiktok is a social media platform for sharing and creating 15-second videos on cellphones, it has a personalized feed that allows users to upload videos with music and sound effects, the app is considered to have a high level of engagement.

The wide dynamic audience is the reason most of the showcasing campaigns these days are centered on social media marketing. As our individual representation on social media gets to be more imperative, so does the representation of the businesses. In order to remain competitive on the market, firms ought to be beyond any doubt that they are well represented on diverse social platforms, have a solid association with their customers, and make the services they provide user-friendly and consistent with the consumers.

The marketing instruments have changed through time: from basic banners and content advertisements to close association and communication with customers, where they do not only tune in, but interact, provide feedback, ask questions and share opinions. These changes led to the appearance of the primary influencers and content creators on social media, who afterward began to cooperate with businesses and got to be an important element within the creation of marketing strategy.

These days the concept of influencer could be a whole social phenomenon, they are the "leaders of opinions", whereas influencer marketing is a multi-million dollar industry that keeps developing. The number of businesses making partnerships with influencers in order to promote their merchandise and services is expanding. Companies need to adjust to the realities of the time and construct their business and promoting techniques smartly in order to remain on the market and keep their brand image.

1.1. Research relevancy

This study aims to understand the growing industry of influencer marketing and compare two of the greatest online influencer marketing platforms, Instagram and

TikTok. It attempts to assist businesses in understanding whether they need to utilize collaborations with influencers for their marketing strategies, how each influencer marketing platform works, and what are the criteria for choosing a particular platform for the business. For this purpose, information is collected using brief interviews with companies, Influencers, and social media specialists.

1.2. Research questions

The research has multiple questions to answer:

- What are the advantages and disadvantages of using influencer marketing platforms?
- What are the main benefits a business can gain from using influencer marketing?
- What are the factors that should be considered when building an influencer marketing strategy?

2. Literature review

2.1. Social media for business

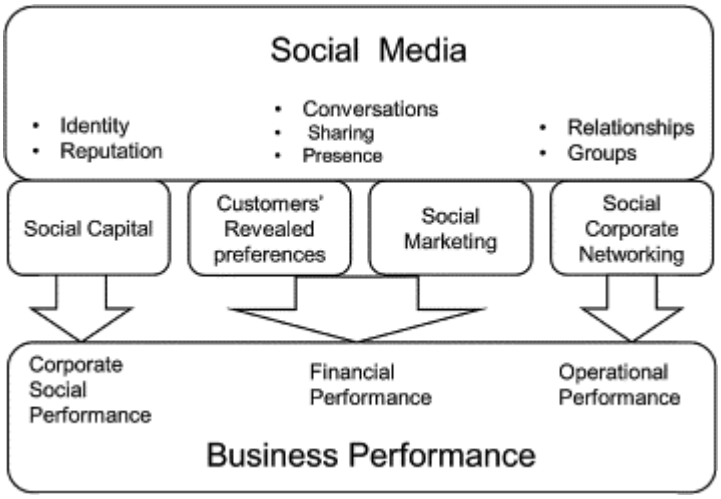
Social media is a new phenomenon that hit the world and grew exponentially over the past two decades. There are several definitions provided by different sources, for example, the Cambridge dictionary (2020) defines social media as a form of media that allows people to communicate and share information using the internet or mobile phones, and the Merriam-Webster dictionary (2020) defines social media as a form of electronic communication (e.g. websites for social networking, microblogging) through which users create online communities to share information, ideas, personal messages, and other content (e.g. photos or videos).

With this growth in the number of users on social media networks, and with digitalization becoming a part of the world's everyday life, many businesses decided to adopt social networking sites into their corporate strategies, businesses saw an opportunity to connect with their consumers like never before. Moreover, most large organization are already on social media and are trying to grow their communities and followers to gain more brand recognition (Wijaya et al. 2009).

Furthermore, with the current highly competitive market in most industries, organizations are not limited to one form of content sharing sites, social media is allowing businesses to take advantage of their strengths and giving them an advantage of focusing on a certain community that their competitors are not targeting. For example, a business could focus on content communities, blogs, forums, news sites, virtual worlds and other types of content and can emphasize spreading their brand awareness and building communities on sites that their competitors are not using (Kaplan–Haenlein 2010), making social media a high priority for most organizations. Most large organizations are now present on multiple social media platforms to connect with more of their consumers (Paniagua–Sapena 2014).

According to Paniagua and Sapena (2014), Figure (1) shows us how social media and the resources provided by platforms can assist in the increase the development of business performance in financial, operational and corporate social performances:

Figure 1 Social media and business performance channels



Source: Paniagua–Sapena (2014)

Furthermore, in a study conducted by Venkatraman and Ramanujam (1986), business performance is categorized into three different categories:

- Corporate social performance: The organization's ability to create a sincere relationship with their consumers, institutions, communities, and societies, focusing mainly on their brand's image and reputation.
- Financial performance measures the organization's ability to use its assets from its primary mode of business and how it generates sales level, growth, profitability, and stock prices using those assets.
- Operational performance refers to the organization's performance against prescribed standards such as regulation compliance, the reduction of waste, and productivity. Examples of operational performance are the introduction of new products, increasing product quality, elimination of waste, and increasing the level of consumer satisfaction.

Each performance is affected through a certain channel: social capital, customers' revealed preferences, social marketing or social corporate networking. Each channel consists of several social media functional resources: identity, conversations, sharing, presence, relationships, reputation and groups. (Kietzmann et al. 2011).

Social media provides much more than only growing a business's followers and increasing their brand awareness, it provides most businesses with an insight into other businesses' online strategies and products. A business can benefit from social media by finding new business opportunities, developing new ideas for their brand, discovering

methods to deepen their relationship with their followers by communicating with them, and even building relationships with other businesses to collaborate on projects (Gillin and Schwartzman 2011).

Mckinsey & Company is a management and consulting company that conducted a survey that showed that 69% of companies around the world reported significant benefits from using social media platforms. The benefits varied from an increase in sales and revenue, an increase in efficiency while running marketing campaigns, an increase in their brand awareness, to higher consumer involvement in the process of developing their products and services (Bughin et al 2009).

2.2. The "word-of-mouth" marketing

One of the main aspects of marketing that social media has changed is "word-of-mouth" marketing (WOM). The term was changed to E-WOM or "electronic word-of-mouth" marketing. According to Richins (1984), the idea of "word-of-mouth" comes from consumers having used a product or service and having the need to share their experience of said product or service with their friends and family; or a community they are a part of. By sharing their experience they spread their positive, or in some cases negative, experience with other consumers.

There are many reasons researchers believe that individuals have a "need" to share their experiences, and Henning-Thurau et al. (2004) developed a framework to attempt to understand what motivates consumers to share their experiences, and had categorized these motives into five categories:

- Focus related utility: the need to add value to the community the individual is part of, focus related utility motivates the consumer to attempt to help their fellow community members by sharing their experience, negative or positive.
- Consumption utility: when an individual is assisted by another community member's experience in their own purchase, the individual is then motivated to help the other community members the same way they were helped.
- Approval utility: when an individual receives praise from the community for their contribution; whether formal or informal praise.
- Moderator related utility: this type of motive is more towards negative experiences, and it is when there is a third party that relays the community's experience to the producers or retailers.
- Homeostase utility: the final type of motivation comes from "Balance Theory", and it is when an individual tries to keep a balanced state, which is, in purchasing, when a consumer buys a product and is either impacted positively or negatively by it, then the consumer tries to praise the product to their community; or vent their frustrations if it was a negative experience.

Nielsen is a marketing organization that helps its clients, which are usually businesses, to connect with the audience they need to reach; whether it is through social media, streaming clients, or even podcasts. Nielsen (2015) had a survey done that showed that 92% of consumers believe in the experiences that their friends, family, or people in their community have had with a product or service over any other form of advertisement.

The data from the survey could be interpreted to show that the opinion of consumes about products and services can greatly influence the opinion of many other consumers, which is what makes WOM market such a powerful tool.

In recent studies, data has shown that younger consumers will usually check online before buying a product, to check the reviews and experiences of other consumers. Furthermore, younger consumers use social media platforms and other websites to compare the products they are interested in with other products from competing companies, making social media an extremely important tool when it comes to spreading word-of-mouth for most products (Sasmita et al. 2015).

With this major increase in the usage of the internet and social media, businesses have started to use social media as a great tool to control word-of-mouth and to help increase the awareness of their brands. Furthermore, marketers have also now been able to find another tool to use in their social media strategy, which is influencers, influencers have the power to start this "word-of-mouth chain", open the discussion about their personal experience with a brand or product, and influence the decision-making process of other consumers.

2.3. Influencers

Social media platforms have now over 3.6 billion users worldwide, according to Statista (2021), and the number of users are only expected to grow in upcoming years. With this increase in number of users across all platforms, users are currently consuming content at a never before seen pace, which gave many content creators a large number of followers, with such content creators now being called "influencers" or "leaders of opinion".

In a study conducted by Fredberg et al. (2011), influencers are defined as a new type of independent third party individual or group that organizations can use as an endorser to a product or service. The influencer usually has a large following due to the audience enjoying their content, whether it is blogs, tweets, videos, or live streaming on a specific platform. Influencers are usually also social media users that gained benefit from being on social networks with a large following. The benefits are either tangible, such as money, or intangible, such as fame.

Although social media influencers are considered a new concept, the concept of influence is not. Researchers have been trying to analyze this concept for a very long time, and have not been able to measure it, since influence is intangible. However, marketers have been using the phenomena of influence and celebrity for many years before the boom of the internet. There are many examples of celebrities used for their influence, for example, Marilyn Monroe was used in an advertisement campaign for Westmore cosmetics in 1952, Michael Jordan is one of the biggest basketball superstars of all time, and with his Nike sponsorship and advertisements he managed to make Nike one of the leading sports apparel companies in the 1990's (Jahnke et al. 2018).

Many social media users who follow influencers on any social media platform could consider these influencers are role models, which makes many organizations consider them as high business value assets. In many cases, these influencers are experts in a certain specific field, making their followers interested in that field as well. Today, one can find influencers in almost any field: sports, parenting, musicians, painters, even professional video gamers. Unlike celebrities, influencers could not have a very broad

demographic of followers, on the contrary, they could have a niche number of loyal followers (Geppert et al 2016).

For example, PewDiePie is one of the biggest YouTubers in the world, with 109,561,457 subscribers, which is the second highest number of subscribers on the entire site. However, one could ask many people who have no interest in gaming and they would not know who he is (YouTube 2021).

As mentioned previously, being an influencer does not require a user to be a celebrity, however, it requires them to have content, whether it is blog posts, videos, photos, or even a streaming channel, which is the reason behind naming them "content creators". Also, unlike celebrities, the followers view this content for the influencer's take and experience with a brand, whereas celebrities are just using their fame to deliver the brand's message, which in many cases makes influencers more relatable to the viewers (Geppert et al. 2016).

The loyalty these followers have for the influencers they are following is usually developed by constant day to day "communication" between them, influencers share their content and the followers usually comment, react, and share the posts. Thus, in order to build trust with the followers, influencers have to create content on almost a daily basis, making it a full time job. The content created is then reacted to by the followers, making them a constant part of the community.

Influencers will assist companies in reaching out to new potential customers and increasing follower involvement. Growing the number of followers might help businesses to get more targeted users viewing their posts, sales promotions and product offerings, which can lead to the growth of the number of sales.

However, when a company uses an influencer as a spokesperson for their brand, the brand and the influencer become interconnected. Putting both their brands in jeopardy if one of them is viewed in a bad light, making many bad reviews on the influencer's behalf is a big issue for company's image, and if the company's products or services are considered bad, that would majorly affect the influencer's credibility, making them lose many followers.

In a case that happened in 2017, a scandal occurred on very large scale that cost many influencers their credibility, costing them many followers and scrutiny from the community. The scandal involved the Fyre music festival. The festival was set to be in the Bahamas and was supposedly going to be a high-end music festival, with a great number of musical artists coming to perform (Stanwick–Stanwick 2019).

However, what the festivals attendees arrived to was far from that: no accommodations, food, water, or medical care, causing alarm and panic among them. This led to a great number of lawsuits against the organizers of the festival, for breaching consumer protection statutes (Stanwick–Stanwick 2019).

The Fyre Festival marketing campaign was an extremely large one, the festival used over 400 different influencers on multiple social media platforms to advertise for their festival, generating a large buzz around the festival and reaching over 300 million people in less than two days. The influencers were paid between $20,000 to $250,000 per post related to the festival. Needless to say the tickets were sold out immediately (Gilbert et al. 2020).

However, since the festival was a disaster, the image and credibility of many of the influencers sharing the news of the fire festival were seriously compromised.

Furthermore, lawsuits were not only filed against the festival. The festival bankruptcy trustee also sued many of the influencers causing their reputation to be further damaged; the Fyre Festival LLC sued the influencers on the grounds that the money paid was part of a scheme to defraud investors (Stanwick–Stanwick 2019).

The influencer marketing industry is growing rapidly, and unlike previously when one could only measure an influencer through the number of followers (which could have been fake accounts), now marketers are able to use programs and platforms such as Google Analytics, Leadfeeder, Foxmetrics, and many others. Allowing businesses to check their ROI (Return on investment), a performance measure used to evaluate the efficiency or profitability of an investment or compare the efficiency of a number of different investments, website traffic, currently as a platform inside the Google Marketing Platform brand (Welcome to Google Analytics 2021).

2.4. Influencer marketing

"'Influencer marketing' can be defined as a form of marketing in which focus is placed on specific key individuals rather than the target market as a whole. Influencer marketing on social media opens up a new channel for businesses to connect with consumers more directly, to be more understandable and closer to their audience and to form a good image of their product." UKEssays (2018).

The dissemination of innovations communication theory states that a minority of users, called "influentials", have exceptional capacities in influencing others (Rogers 1962). This theory predicts that by focusing on these influentials within the network, one may accomplish a great chain response of impact, driven by the word-of-mouth with least marketing costs (Hepp 2018).

There are numerous sorts of influencer collaborations, and some of the most known ones are supported content, brand ambassador programs and affiliate marketing. Next each of them is discussed.

Supported Content: In many cases when marketers decide to use influencer marketing, the customer concludes that the interest of the influencer is more commercial than true, it might have a negative impact on the advertisement and would not benefit the sponsoring company (Speed–Thompson 2000). Furthermore, in spite of the fact that the popularity of the sponsored content on Instagram and other social media networks has been developing, the customers are not continuously happy with the associations of the influencers with the some of the brands online, due to the lack of validity in paid collaborations. When viewing some of the comments on SMIs' channels, the comments regularly uncover disappointment and outrage from doubtful followers toward sponsored brand content (Uzunoğlu–Kip 2014).

A Brand Ambassador is someone who is enthusiastic about an organization or its brand, and participates in activities, frequently on social media, that give brand meaning for buyers (Ambroise et al. 2014). Brand ambassadors are the organizational representatives who humanize the brand and encourage the social connections with an organization (Ambroise et al. 2014).

Affiliate marketing is a prevalent sort of web business promotion in which an affiliate is compensated for each visitor, subscriber or customer they refer. One of the foremost well-known cases is Amazon's "Associates program". Amazon permits web

sites to connect to Amazon and earn a 15% expense for any sales from customers that came from the partner web site (Biyalogorsky et al. 2003). In this case the affiliate plays the part of the influencer promoting Amazon.

In this study, some data is gathered from statistics by Mediakix, an organization founded in 2011 in Venice Beach, California, which is one of the early influencer marketing agencies with over 20,000 sponsored placements. They aim to provide marketers with the latest strategies to create an effective influencer marketing program (Mediakix 2021).

With data provided by Mediakix (2021), the foremost common important objectives for influencer marketing techniques are expanding the brand awareness – 85%, reaching new audience – 71%, producing sales – 64%, progressing brand advocacy – 44%, and driving lead generation – 42% (Mediakix 2021).

Within the most recent survey of Mediakix (2021), most of the companies pointed out that identifying the fake followers and inauthentic engagement is their main influencer marketing challenge.

The Instagram Audience Credibility Checker is the foremost accommodating instrument for spotting fake followers and inauthentic engagement in order to guarantee productive influencer campaigns and security of the businesses. Unfortunately, on the rise of influencer marketing numerous content creators found a way to control the number of followers and fake the engagement rate on their accounts, which ended up as a major risk for the reputation of the brands that are planning to partner with them. In order to maintain a strategic distance from any false schemes with the analytics of Instagram, companies might utilize this instrument and spot the fake accounts. The Audience Credibility Checker is not an official tool of Instagram, but it could be a great platform to guarantee the safety of the business (Johnson et al. 2019).

Another vital issue for the companies working with influencers was the method of finding the proper influencer who can become the representative of their company. Choosing the right influencer is an important factor for the success of the marketing strategy. The proper influencer ought to be reliable within the eyes of the audience. An extraordinary expert in a certain field, which is specifically associated with the business, should be able to deliver the general message and values of the brand.

These days with the developing influencer industry companies do not have to spend a parcel of time looking and checking the foundation of the influencer any longer. There are a few valuable online marketing platforms that can help a company discover and connect with an influencer for their particular field. These platforms contain all the information and freely accessible data of the influencers: the specialty, number of followers, evaluated engagement rate, assessed budget, basic audience information (sexual orientation, age, area) etc.

For example, the marketing platform Upfluence, promising to "find the perfect influencers from your own visitors or within Upfluence 3M+ list and turn them into long-term ambassadors in minutes" (Upfluence 2020), has been revolutionizing the way brands connect with the influencers. The program is utilizing AI in order to gather and analyze the information of the company and make influencers and brand ambassadors from their customers, which can provide both parties advantages from these collaborations.

One more factor which plays a noteworthy part within the decision of some firms to dodge associations with influencers in building a marketing strategy is the challenges that a few businesses encounter when it comes to measuring the assessed costs of the campaign.

2.5. The different influencer marketing platforms

2.5.1. Instagram

Instagram is an American photo and video sharing app established in 2010. Instagram has around 1 billion active users month to month and 500 million active accounts every day. More than 25 million businesses owned an account on Instagram by 2020 (Statista 2020).

The statistical information of Facebook (2021) shows that the top reported interests of Instagram clients are travel (45%), music (44%) and food and drink (43%) (Business of Apps 2020).

Concurring to Statista (2020), the top-countries by Instagram users are USA with 110 million users, Brazil – 70 million, India – 69 million, Indonesia – 59 million, and Russia – 40 million (Statista 2020).

Within the later survey of Mediakix (2019), 69% of marketers replied that Instagram is the influencer marketing channel they will spend the foremost of the budget on. Instagram was followed by YouTube with 11%, and blogs with 7% (Mediakix 2019).

Taking after the success of the cooperation with businesses Instagram introduced the Business profile, permitting to see the particular information and metrics such as the number of profile visits, number of profiles reached by a post, how many times the post was saved, age and sexual orientation of the audience, etc. These highlights offer assistance to analyze the preferences of the audience and which sort of content is more successful.

Nowadays more marketers are attempting to analyze and work with the calculations of Instagram in order to make their content more obvious for the customers. One of the foremost popular ways to publicize products on Instagram presently is to form a partnership with an influencer. Paid collaborations between brands and SMIs are commonly realized within the shape of sponsored content (Stubb–Nyström 2019). More often than not the influencer reviews and publishes the impressions about the product and gets a recompense from the sponsoring company. The partnerships with brands are mostly the primary source of income of the influencers on Instagram.

There are more than 500 thousand active influencers on Instagram. As the audience of the app and the partnership between the influencers and businesses keeps growing, the marketing and advertisement is still considered to be the least demanding and cheapest way for companies to attract new clients.

Following the success of other video sharing apps and social networking services, Instagram has also developed new functions for their users to create various video content on their platform: story, live stream, video in profile feed, and IGTV (Instagam 2021).

2.5.2. TikTok

TikTok is a video sharing app presented by a Chinese company ByteDance in 2016 and known as Douyin in its domestic market. After blending with the social/live streaming app Musical.ly, it was pushed into the worldwide market. TikTok permits users to make, share and see 15-second-long recordings with music in the background. The users can moreover connect a few brief clips together for up to 60 seconds of the full length of the video or upload longer recordings which have been recorded outside the app. In addition, there is a live-streaming choice and an assortment of filters and instruments to assist progress in the video content.

Moreover, each user has the "For You" personalized page that is designed for giving suggested content, which is the foremost significant and suits the preferences of the user based on the content they have already interacted with. Typically this is the reason why the most well-known hashtags on the app are #foryou and #foryourpage (TikTok 2021).

In 2018, from August to October, Tiktok's month to month active users grew from 100 million to 130 million (Sensor Tower 2020). In Q1 2020 TikTok had the foremost downloads for any app ever in a quarter, with 315 million installs over the App Store and Google Play (Sensor Tower 2020).

TikTok can be the perfect platform for focusing on millennials and gen-Z clients with brand advancements. As a relatively new social platform, TikTok's users are dynamic and mobile youthful individuals. This fact helped TikTok to become the app with the most elevated average engagement rate leaving behind such enormous platforms like Instagram, Facebook and YouTube.

This fact made marketers turn to TikTok to promote their brands, particularly in case they are searching for the more youthful audience. TikTok is additionally a great way to bring a tremendous traffic to the official website of the company or the accounts on other social networking platforms, for example, Instagram. Such large and well-known brands like Guess, Red Bull, NBA, The Washington Post, Nickelodeon and numerous others are as of now present on TikTok.

In spite of the exceptional results of the app, the algorithms of the platform are still obscure and numerous marketers do not need to take a chance and utilize it for business purposes. Concurring to Social Media Industry Report in 2020 as it were, 5% of marketers are utilizing TikTok in their marketing strategy. A critical 74% do not plan on utilizing the platform within the next year, and 30% are curious about learning more about TikTok (Social Media Inspector 2020).

Right now there are many ways for businesses to promote their company: in-feed advertisements, brand takeover advertisements, hashtag challenge advertisements, shoppable advertisements "Hashtag Challenge Plus", branded TikTok stickers, and influencer promoting advertisements.

Due to TikTok being a new platform, very little literature is available online. Moreover, due to it being run by a the Chinese company Douyin, data about the website is not available for public use online. However, this study attempts to use Mediakix's data provided online, and as mentioned, Mediakix is one of the leading influencer marketing companies in the United States (Mediakix 2021).

In-feed advertisements are exceptionally natural for the TikTok's short-video content. There are three action models for this sort of ads: CPC (cost per click), CPM (cost per impression) and CPV (cost per 6-second view). The app's targeting is based on location, age and gender. The cost for the in-feed advertisements is $10 cost-per-impression with a $6,000 minimum campaign spending (Mediakix 2021).

Brand takeovers are shown instantly when the user opens the ad, which makes them exceptionally effective and visible for the audience. It guarantees more than 5 million impressions for a day of takeover. The primary objective of these advertisements is to make users click on the Call to Action button and visit a certain link of the brand inside or outside the app. The brand takeover advertisements are accessible for purchasing for a few categories of businesses (e.g. fitness, fashion, food, etc.). TikTok offers only one brand to take over an industry category per day. Brands might pay approximately $50 thousand dollars for a day of brand takeover (Mediakix 2021).

Hashtag Challenge Advertisements is one of the foremost well-known advertisement on the app. This sort of advertisement promotes users to produce their own content featuring their personal cooperation within the challenge of the brand. The discover page on TikTok gives examples of other content created by users and gives the instructions for the challenge. The Hashtag Challenges could be created without any installment, but the paid content of TiKTok ensures the next level of engagement (Mediakix 2021).

The shoppable advertisements of "Hashtag Challenge Plus" permit brands to create hashtag challenges and make experiences for users that permit them to buy the products or services of the brand. On the hashtag challenge page potential customers can find the Video Tab with the content produced by other users and the Explore Tab with items shown by the company and the "Shop Now" link to the external site where they can make their purchase (Mediakix, 2021).

Brand TikTok stickers are branded video effects that TikTokers might utilize in their content. This strategy assists advertisements to generate higher engagement more naturally, without any "invasion" compared to other conventional disruptive advertisements (Mediakix 2021).

TikTok influencer marketing advertisements empowers companies to collaborate with TikTok creators that will offer assistance to create and share the sponsored content with their followers. With the extension and further advancement of the app the tracking capabilities of the platform will permit businesses to have access to more details about the execution of the marketing campaign (Mediakix 2021).

The time of the filtered perfect pictures and faces on media is coming to an end, and individuals are trying to find something new, a more natural and live content they can relate to. As consumers are becoming more doubtful about the ads, TikTok could be an extraordinary platform where it is possible to present a brand and show it being a part of the lifestyle of the buyers.

Among the foremost well-known businesses on TikTok are, for example, boutiques and fashion clothing stores with the try-on recordings on their channels. A few other businesses are utilizing TikTok in order to show the method of production and operations of the firms, "behind the scenes". Guess was one of the primary popular brands that collaborated with TikTok for their campaign #inmydenim in US.

In September of 2020 Oracle and Walmart agreed to secure 20% of the shares of TikTok's worldwide business, which got to be the conclusion of the long debate between the government of the USA and ByteDance video-sharing platform (Forbes 2020). This was the only way for TikTok's owners to urge the endorsement of Donald Trump in order to keep the operation of the app in the USA, which is the 2nd nation on the list of nations where TikTok had the most downloads (Statista 2020).

3. Methodology

3.1. Philosophical approach

There are many philosophical paradigms when it comes to researching a topic, and each one is associated with a different way of gathering and analyzing information. The "paradigm wars" have been an issue that researchers cannot agree upon for many decades, and the two main paradigms are the following:

1. Positivism is a paradigm under objectivism, epistemology is a methodological philosophy which is a type of quantitative research. In this paradigm researchers should apply the methods of natural sciences in order to discover the study of social science (Crotty 1998).

2. Interpretism is a philosophical approach based on the belief that studies about people and society cannot use the same methods that are used by physical sciences, as people interpret the world and then act based on their personal interpretation while the world does not. Interpretivists adapt a relativist ontology where a single phenomenon may have multiple interpretations rather than a truth that can be determined by a process of measurement (Pham 2018).

For this study, the researcher believes that the most suitable approach is Interpretism, due to the study being about social science and is based on interviews to understand the experience of companies with influencers, how influencers are starting their businesses, and what social media experts believe is the best way to navigate these platforms. Hence, due to all the information being interpretations of the data, the most suitable paradigm is Interpretism.

3.2. Data collection and analysis

There are two main data types in research, qualitative data and quantitative data. First, qualitative data, which is the type of data that cannot be quantified, for example, life experience and insight knowledge of the person being interviewed, the personal opinions, thoughts, and views in a certain context and circumstances (Nieswiadomy 2002), which is the only way for a researcher to develop a precise hypothesis using their findings.

Second, quantitative data, which is the type of data using numbers for the generalization of the findings in order to use the results for other situations that require the same statistical data. The research objectivity is of utmost concern. The observed and measured data should be kept from "contamination" with the researcher's personal involvement with the research subjects (Thomas et al. 2011).

In this study, due to the data being acquired through interviews, and due to the fact that this research is following the Interpretism paradigm, the study uses qualitative data.

3.3. Data collection tool

In this study, the data have been gathered using short interviews with companies, influencers, and social media experts.

According to Boyce and Neale (2006: 3), an interview is a qualitative research method that includes "conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program or situation".

The advantage of the interview research method is the possibility to collect more detailed insight data concerning the research subject and elucidate the issues that might appear during the process of interviewing. The disadvantages of this type of primary data collection include the arrangement of the interviews with the members of the sample group, as the interviews require an effective scheduling of time and an appropriate environment.

The questions covered the information about the interviewee, the reasoning behind their preference in social media platforms, and what their future plans are with regards to their social media marketing strategy. The questions of the interview can be seen in the Appendix (Appendix, Interview Questions).

4. Interviews

There were four interviews done for this study, two were with small businesses (SMEs) and two with large companies, which are documented and discussed in this section.

4.1. SME interviews

En Flique, Miss Katarina Mogus

En Flique is an online social media agency, based in Toronto, Canada. The agency targets other small businesses, blogs, and start-up applications as their main clientele, and helps them by enhancing their online strategy to grow their follower count. The interview was conducted with the CEO of En Flique, Miss Katarina Mogus, who started her company by sharing "small tips for growing your TikTok and Instagram followers" videos on TikTok. These videos went viral in 2020, making her an influencer, which allowed her to gain a big following on both TikTok and Instagram, and to publish a book under the title "Powerful Presence", which is a guide for small businesses for using Instagram in their online strategy.

Miss Mogus used her large online presence to start her business. Like many other social media influencers, En Flique currently has 167 thousand followers on Instagram and over 1.9 million followers on TikTok. Moreover, Miss Mogus also is also currently in charge of managing both accounts. As she is the only En Flique employee, and only uses statistical data provided by the Instagram and TikTok platforms, she currently does not use any social media metrics third party applications, and believes it is much more effective when one grows one's presence personally and without using paid advertisements.

En Flique's targeted demographic is the younger audience and entrepreneurs, the largest group of En Flique followers were 24 year old females from the United States. The main problem Miss Mogus faced in the past couple of years was shaky political relations between the United States and China, which almost caused the United States to ban the use of the TikTok application there, which would have been a big blow to her online follower base.

Leyla Elmans, Vladislava Alexeenko

Leyla Elmans is a small Azerbaijani silk shawl company from Moldova. Leyla Elmans is a fully online run business, which uses Facebook and Instagram as their main marketing tools. The owner of the company, Miss Alexeenko, runs all the social media platforms herself, due to the company having only three employees. Miss Alexeenko believes that since the company is running on an online basis, there is no need for a larger number of employees yet.

However, Miss Alexeenko chose operating the entire business on Instagram and Facebook, due to them being affordable platforms. Since Instagram is owned by Facebook, they both have a shared advertisement fee, and they are easy to use in terms of platforms for businesses. The business data is easy to acquire, the set-up of the business is not overly complicated, and communicating with customers is extremely easy. The next step for Leyla Elmans is to open a physical showroom in Chisinau, however, Miss Alexeenko believes that the online store will always be up and running.

Furthermore, after running the whole business using social media platforms, Miss Alexeenko decided to partner with a travel agency and some well-known Moldovan influencers. The idea behind this collaboration was a giveaway, one of the most popular methods of promotion when using influencer marketing. The winners received either a travel tour or shawls from Leyla Elmans, and the conditions for the giveaway was to simply comment on the post and be a follower of all the organizers of the giveaway. The winner was picked by Instagram's Random Comment Picker. Miss Alexeenko believes that the giveaway brought the business a lot of online traffic and that it is a great way of getting awareness towards their brands. It is very important to pick the correct Influencers for one's business.

The Leyla Elmans' Instagram and Facebook accounts are run entirely by Miss Alexeenko, and she does not use any third party programs to measure the traffic: they use the internal statistics provided for business account on Instagram. Moreover, Leyla Elmans do not plan on starting a TikTok account, as they believe that TikTok is more geared towards a younger audience and that is not the demographic they are targeting.

4.2. Large Enterprises

CMA CGM SA. , Adey Al-Awamleh

CMA CGM is an international shipping company with over 110 thousand employees around the world. Its headquarters are in Marseille, France, and it is one of the world's leading shipping companies, providing freight maritime transport to over 150 countries.

The interview was conducted with Adey Al-Awamleh, a marketing officer in the Jordanian branch of CMA CGM. In the interview Mr. Awamleh talked about the

company's current Instagram pages, the Jordanian branch has a separate Instagram account than the main branch, to make it easier to communicate with their customers. It does not have much traffic, with less than 400 followers. He explained that since most of their business in Jordan is corporate, the page is not as active as they would like it to be. Moreover, they are more focused on LinkedIn to connect with other businesses, since it is more focused on (B2B).

The account of the main branch has currently over 115 thousand followers on Instagram, with thousands of likes on each posts. Mr. Awamleh believes that the main use of the Jordanian branch's account is for more brand awareness and to advertise any new promotions or milestones for the company, as they cannot post anything unless an approval is provided from the main branch.

Due to the company only targeting businesses in Jordan and Instagram being more frequented by younger audience in Jordan, which is not the targeted demographic, Mr. Awamleh believes that the Instagram page must be updated regularly but should not be one of the main tools for their marketing strategy. Mr. Awamleh feels that the Jordanian branch's current followers could be increased, however, it would be difficult due to the approval needed from headquarters for each post. The company is planning on gathering as many followers on the Jordanian branch to increase brand awareness and to advertise the company's promotions, but it is not one of their top priorities at the moment. The company does not have a TikTok account and is not planning on using influencer marketing in the near future, as it is also not their targeted demographic.

Amazon, Jordan branch, Khaled Jaber

Amazon is an American multinational technology company and one of the largest organizations in the world. Amazon provides its customers with many services such as online streaming of movies and series, cloud computing services, online commerce, and the company is even working on artificial intelligence.

Khaled Jaber is a junior manager at Amazon's customer service's branch in Amman, Jordan. Furthermore, Mr. Jaber handles not only customer feedback on the Amazon site, but also monitors any customer issues coming through social media. According to Mr. Jaber, Amazon uses many social media platforms, for many different purposes. For example, Amazon has a very successful Instagram page with over 3.1 million followers, used to connect with their customers through regularly updated posts. They use Twitter for PR and to connect more with their United States customers, Twitter being mostly popular in the United States. They post of Facebook regularly, the company owns a video game streaming platform called Twitch, and people can contact them from any platform for customer service.

According to Mr. Jaber, Amazon uses a social media management tool to keep track of how many messages, comments and Tweets they receive on daily basis, and their metrics are sentiment analysis and response time, and by using these they can track the average response time of the company, and sentiments of the users, and how much customers are satisfied with their services.

As for influencer marketing, Amazon has their own influencer strategy called the Amazon influencer marketing program, which allows users to get their own web page on Amazon. This page will show the products that are recommended to their

followers. The influencer promotes the page and receives an amount for each purchase coming from their Amazon page.

Moreover, this program is offered to any type of influencer on any platform as long as they have an acceptable number of followers, and according to the number of followers and other social media engagement metrics, the influencer can qualify for the program.

As for TikTok, Amazon seems to have many influencers on TikTok that are part of the influencer marketing program, but does not have an official TikTok page.

Discussion

The interviews with the large enterprises showed different uses of Instagram and TikTok for both organizations. CMA CGM SA. is a large shipping company and due to it being more focused on corporate shipping, reaching the demographics they target would be difficult through the use of TikTok, which explains why they are uninterested in using the platform for their online strategy. The same goes for Influencer marketing, it would be difficult to find an influencer that has a large number of followers that are interested in Maritime shipping.

However, they do still use Instagram, although Jordan does not have a large Instagram user base, they still use it for "Brand Recognition". On the other hand, Amazon is a much larger corporation and is utilizing the influencer marketing to the maximum with their Amazon Influencer Marketing program, giving a chance for any influencer to represent their company if they meet the requirements needed to join the program.

As for the small businesses, the interviews showed a large contrast in their social media platform usage. One was more TikTok focused and was an influencer herself, while the other only used Instagram, and hired influencers as a collaboration. This difference could be due to the targeted demographics, number of users on each platform, or the popularity in each country.

The Interviews showed that influencer marketing can benefit businesses. However, it also showed that businesses should choose which platform they use according to the country they are in and the demographics they are targeting. For example, if your target demographic are younger users and the business is located in Indonesia, which has the highest number of active TikTok users worldwide, then TikTok would be the platform the business should focus on.

5. Conclusion

Social media has changed our day to day life in so many respects, and especially with COVID-19 forcing people to stay at home, the use of the internet and these platforms have increased dramatically. We now use social media for communication, learning, entertainment, and even for work purposes.

There has been a significant increase in the number of people on all social media platforms, and with this increase in the number of users viewing all sorts of content, this gave rise to influencers or "leaders of opinion", which are experts in certain fields with many followers viewing their content.

This study has attempted to explore the concept of influencer marketing and its recent sharp growth of popularity in the digital world, and attempted to compare two of the biggest online influencer marketing platforms, Instagram and TikTok. Even though many businesses are already present on these social platforms and have influencers that represent their companies, most of them still do not have a clear view and understanding of the ways of building an efficient influencer marketing strategy.

From the interviews, the study has shown that at the moment Instagram is more popular with businesses, especially when it comes to influencer marketing platforms. Although advertisements on Instagram is more expensive compared to TikTok, businesses tend to pay more instead of taking risks while working with a fast-growing new platform. Furthermore, most of the information provided in the study by the interviewees showed that mostly younger users are the demographic served by TikTok, which was unfortunate. All the businesses interviewed were targeting an older audience.

All the results obtained show the variety of different ways to promote brands and businesses on influencer marketing platforms and indicate the factors that should be considered for building an efficient marketing campaign for business.

Appendix:

Interview Questions:

1. Can you tell me a bit about your organization? (Organization size, profile, number of employees in the marketing department, day to day activity, etc.)

2. What is your current job title and description?

3. Is TikTok and Instagram a part of the marketing strategy? And how long have you been using it?

4. What made you incorporate Instagram and TikTok into your strategy?

5. How are you currently using these platforms in your organization? And for what purpose?

(Example: word of mouth, informing customers about new products/ services, customer service,

interacting with customers, PR tool, managing the brand).

6. Which platform was more useful for your business: Instagram or TikTok? (Example: brought higher traffic, engagement, sales)

7. How much resources do you put into your TikTok and Instagram marketing strategy?

8. Have you ever had or are you planning in the future to have any collaborations with influencers?

9. How do you measure your effectiveness of using these platforms?

10. What are the problems you are facing when using Instagram and TikTok?

11. What would you like to change in your marketing strategy in future? Will you continue using

both platforms or focus on one of them?

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