ECONOMICS & Sociology

Rybaczewska, M., Kłopocka, A., Kuszewski, T., & Sułkowski, Ł. (2023). Grocery shopping behaviour in the era of COVID-19: Panel data analysis from convenience store sector in England, Scotland and Wales. *Economics and Sociology, 16*(2), 210-228. doi:10.14254/2071-789X.2023/16-2/13

GROCERY SHOPPING BEHAVIOUR IN THE ERA OF COVID-19: PANEL DATA ANALYSIS FROM CONVENIENCE STORE SECTOR IN ENGLAND, SCOTLAND AND WALES

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Received: March, 2022
1st Revision: April, 2023
Accepted: June, 2023

DOI: 10.14254/2071-789X.2023/16-2/13

JEL Classification: D12, D91, M31, M30

ABSTRACT. To the best of our knowledge this is the first attempt to address the consistencies and inconsistencies between the grocery shopping behaviour shifts in the era of Covid-19 across three devolved nations of the mainland UK. We address the strictness of 'lockdown style' closure and containment policies that primarily restrict people's behaviour (stringency index). We use a unique dataset of transactional data (778,305 observations) drawn from 1,282 convenience stores located in England, Scotland and Wales. Panel data analysis covers the pre-pandemic (Jan 2018 – Feb 2020) and pandemic period (March 2020 – Dec 2020). This research reveals that, despite the consistent decrease of single item transactions and increase of average spend per transaction across England, Scotland and Wales, the dynamics of these shifts in time varies meaningfully. All these shifts highly correlate with the stringency index. Analysis of additional explanatory variables i.e. store size, location, affiliation shows further dimensions.

Keywords: grocery shopping, Covid-19 pandemic, consumers' purchase behaviour, England, Scotland, Wales

Introduction

Grocery shopping has been investigated for decades and literature has identified various aspects influencing shifts of consumers' behaviour within this field including market structure (Burt and Sparks 2003; Clarke 2000), online shopping (Elms, de Kervenoael, and Hallsworth 2016; Van Droogenbroeck and Van Hove 2017), ageing processes (Kohijoki 2011; Venn et al. 2017) etc. There is though very explicit claim emphasised by many authors that these issues need further exploration (Filipe, Marques, & Salgueiro, 2017; Leszczyc, Sinha, & Timmermans, 2000; Morganosky & Cude, 2000; Shaw & Alexander, 2008), especially in the context of such unprecedented circumstances as Covid-19 pandemic (Belbag, 2021; Ben Hassen, El Bilali, & Allahyari, 2020; Gordon-Wilson, 2021; Kim, Yang, Min, & White, 2021; Martin-Neuninger & Ruby, 2020). We put the understanding of the shifts of grocery shopping behaviour among priorities of building the knowledge beneficial for not only academics but, above all, business practitioners functioning in the grocery sector.

The reason to conduct our analysis in the British context is the fact that the UK has noted very high numbers of Covid-19 cases and deaths (BBC 2021). More importantly, across this one country we can distinguish various approaches and governmental decisions aiming to reduce the risk of virus spread. The devolved nations of the UK have their own competences in the field of health policy and are able to address the pandemic threat in their own independent way. We contribute towards understanding of grocery shopping patterns and habits in the era of Covid-19 by contextualising them within the similarities and differences between English, Scottish and Welsh governmental regulations and recommendations. Following the approach of such authors like Moffatt et al. (2012) and Neill et al. (2021) we address the unique and shared aspects of three devolved nations. The aim of this study is to reveal the consistencies and inconsistencies in the shifts of grocery shopping behaviour among three devolved nations in the mainland UK implementing various pandemic restrictions. We contextualise our research within the strictness of 'lockdown style' closure and containment policies that primarily restrict people's behaviour (stringency index). To the best of our knowledge it is the first attempt to address this research gap. The theoretical and practical implications of this study are beneficial for policy makers, business practitioners and consumers during various disruptions on the market (not only health but also economy or climate connected).

Our contribution is also connected with the analysis of a unique panel data revealing specific aspects of grocery shopping in the era of Covid-19. Thanks to the real-life transactional data we do not analyse consumers' declarations but their true behaviours. Such investigation makes the consumers, business practitioners and policy makers more aware of consumers' reactions to lockdowns, to make the decision-makers more proactive than reactive in the future.

To reach our goals we divide this paper into eight sections. This introduction is followed by the Conceptual Framework contextualising our research within the literature addressing the analysed issues and explaining our interests. The third section is Data and Methods presenting the unique dataset we use. It also describes our sample of the convenience stores and the applied econometric modelling techniques. It is followed by the Results section discussing the findings of our investigation. Discussion and Conclusions emphasise the meaning and contribution of this study in the context of the addressed circumstances/conditions and literature concerning the investigated field. The fifth section discusses also the limitations of our research, the tasks for future and conclusions. The manuscript is finalised with References.

1. Literature review

1.1. Grocery shopping behaviour and convenience store sector

This paper addresses the grocery shopping behaviour from the perspective of convenience store sector in the mainland UK. This sector is very valuable and important for the UK economy (47,079 convenience stores in the mainland UK account for over one fifth of the UK grocery market, 42,000 jobs, over 8.7bn in taxes last year etc.). It is also relatively resilient during the pandemic when various challenges for business functioning are observed, including supply chains disruptions, panic buying, uncertainty connected with Brexit etc. (ACS & SGF, 2021; Billore & Anisimova, 2021; Rybaczewska, Sułkowski & Bilan, 2021). Convenience stores, being in the heart of their local communities, are strongly connected with the local economy (e.g. Rybaczewska & Sparks, 2020). Moreover the resilience of local communities, 'Love Local' campaign and increasingly widely discussed and implemented concept of 20-minute neighbourhood (SUSTRANS 2021, A New Future for Scotland's Towns Centres 2021) underpin the importance of convenience store sector.

1.2. The mainland UK in the era of Covid-19 pandemic – stringency index

Our study addresses the specific character of the United Kingdom which let the devolved nations to apply their own health policy and thus stimulate the consumers' behaviour. Therefore our research serves distinguishing between grocery shopping habits/patterns contextualised within the policy regulations/restrictions across Scotland, England and Wales, all experiencing the unprecedented challenges and difficulties connected with Covid-19 in their own way.

Tatlow et al. (2021) measured the timing, duration, and stringency of responses to pandemic by Oxford COVID-19 Government Response Tracker (OxCGRT) indicators in all four nations of the UK (England, Scotland, Wales, and Northern Ireland), highlighting their autonomy and legislative powers as devolved nations. They analyse a stringency index, which records the strictness of 'lockdown style' closure and containment policies that primarily restrict people's behaviour. This index is a composite measure (simple average) based on nine response indicators: school closures, workplace closures, restrictions on gathering size, public events cancellations, public transit closures, stay-at-home requirements, public health campaigns, restrictions on internal movement, and restrictions on international travel, rescaled to a value from 0 to 100 (100 = strictest). The exhaustive description of OxCGRT methodology is provided by Hale et al. (2021), Tatlow et al. (2021) who recognise that although broad pattern over the pandemic period has been similar (the UK nations increased and decreased the stringency of closure and containment policies at similar times), there is some variation within the government response (Figure 1).

While Scotland had the highest average Stringency Index value during all days in 2020 (with an average value of 58.09), England had the lowest average stringency then (54.94 average value). In this paper we analyse the period ending in December 2020 and it is important to note that in 2020 the stringency index increased for all UK nations, the differences are observable though (Figure 1). Among the key aspects for grocery shopping behaviour we put stay-at home orders. In 2020 they were in place in England for 92 days, Wales for 99 days and Scotland for 68 days. The first stay-at-home order introduced in March 2020 ended in England on 3rd May 2020, and about four weeks later in Scotland (on 29th May) and Wales (on 1st June). England and Wales required people to stay at home for several weeks in October and November of 2020. While Wales ordered another national stay-at-home order on 20th

December 2020, England and Scotland didn't. After the first round of restrictions in March 2020, England reopened some levels of schooling on 1st June 2020, followed by all levels of schooling in Wales on 29th June. In Scotland education remained closed until 22nd July. Schools were closed in Scotland again on 26th December 2020, and in Wales on 14th December. Scotland was the only UK nation not to implement a national 'circuit breaker' style lockdown in October and November 2020. All nations of the UK except for England have introduced distance restrictions on internal movement.

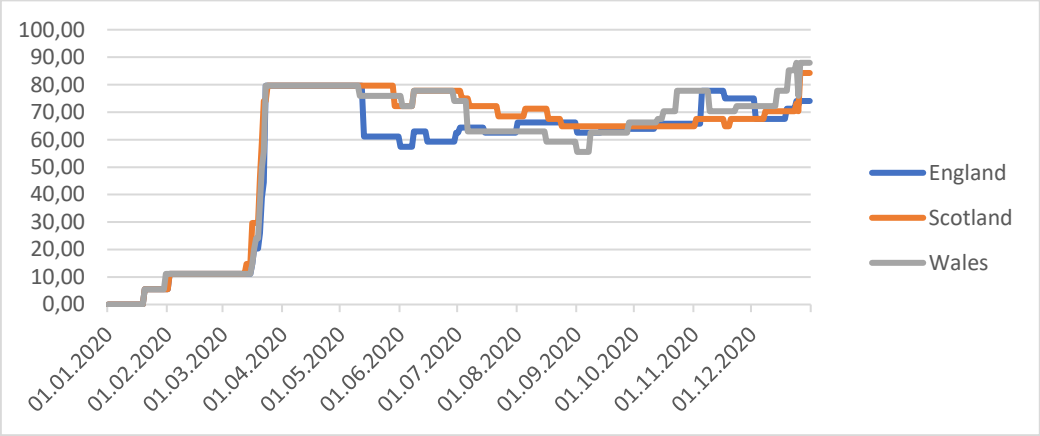

Figure 1. Oxford COVID-19 Government Response Tracker (OxCGRT) average Stringency Index values over time in England, Scotland and Wales (a score between 0 and 100, 100 = strictest).
Source: Author's own upon data of Blavatnik School of Government, University of Oxford.

1.3. Grocery shopping behaviour shifts in the era of Covid-19

Literature explicitly states that the consumers' preferences and behaviours have significantly changed during the pandemic and recognises such aspects like panic buying (Islam et al. 2021), rational and irrational stockpiling (Amaral, Hang, Burns 2021; Martin-Neuninger and Ruby 2020), increase of online sale (Alaimo, Fiore, & Galati, 2020; Koch, Frommeyer, & Schewe, 2020) . We acknowledge the impact of Covid-19 on the overall food behaviour (Ben Hassen et al. 2020; Grashuis, Skevas, and Segovia 2020) and the role of social media in these consumers' reactions to threat (Naeem, 2021; Patma et al., 2020; Taha et al., 2021).

The reviewed literature (e.g. Grashuis, Skevas, & Segovia, 2020; Martin-Neuninger & Ruby, 2020; Sheng, Ketron & Wan, 2021; Sheth, 2020) unambiguously emphasises the existence of such aspects like changing consumers' habits and their continuity (including in-home and out-home consumption), more wide use of technology (including online grocery shopping), panic buying etc. that need further exploration. To the best of our knowledge this is the first attempt to address the consistencies and inconsistencies between the grocery shopping behaviour shifts in the era of Covid-19 across three devolved nations of the mainland UK. Such an approach reveals new perspective on the correlation between the governmental recommendations and consumers' shopping behaviour.

Consumers following the governmental 'stay at home' orders (various in time across Wales, Scotland and England) and 'social distance' recommendation might more willingly buy in their neighbourhood convenience stores or online. They might also buy only one item during their visit in store not as often as before. Another case would be to use this one item shopping opportunity to get any kind of personal interaction while suffering from loneliness resulting from lockdown (Miller, 2020; Palgi et al., 2020). At the same time, though, the consumers using

the Internet to do their shopping may buy only one item that they forget to buy online/need to be fresh (which would increase the number of one item transactions). Acknowledging all these possibilities we hypothesise that overall share of single basket transactions would decrease in times of pandemic. This brings questions about the average basket spend. The convenience store sector may be perceived as resilient during Covid-19 (Rybaczewska, Sułkowski, & Bilan, 2021) thanks to increased number of customers or higher average basket spend.

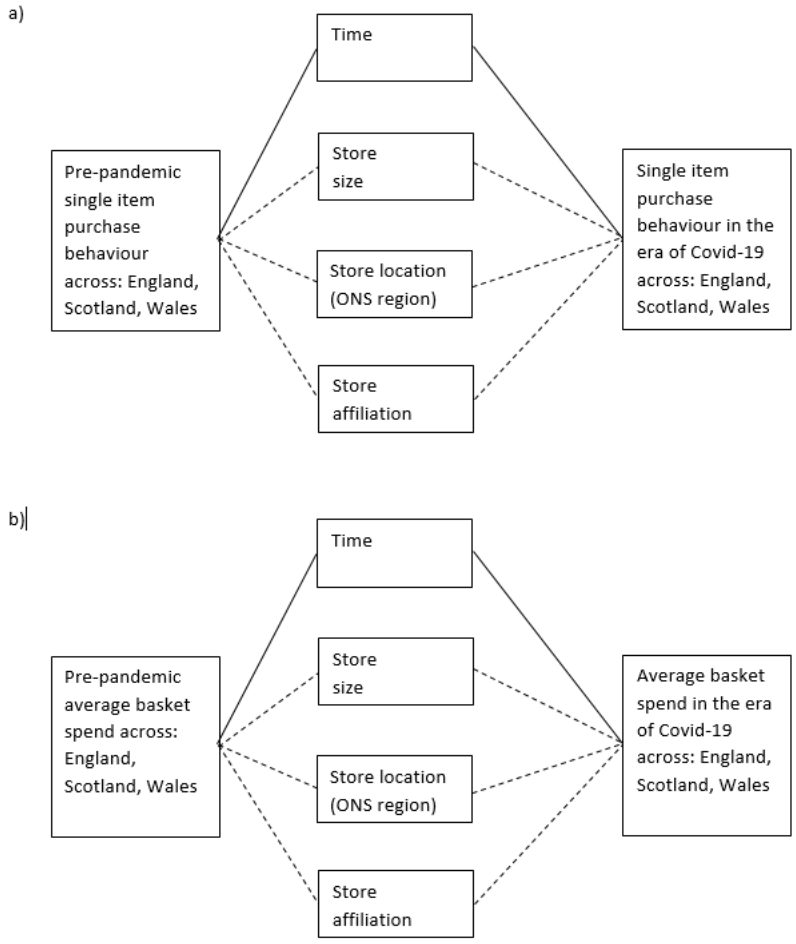

Figure 2. A conceptual framework with the analysed independent and dependent variables concerning the hypothesis 1 (a) and hypothesis 2 (b).

Notes: ——— lines show key independent variable across all analysed devolved nations i.e. England, Scotland, Wales

--------- lines show control variables across three analysed devolved nations i.e. England, Scotland, Wales

Source: Authors' own.

To verify all these in the context of three devolved nations of the mainland UK we formulate two hypotheses:

H1. Decrease of single item purchase behaviour in the grocery sector in the era of Covid-19 is consistent across England, Scotland and Wales.

H2. Increase of average basket spend on grocery shopping in the era of Covid-19 is consistent across England, Scotland and Wales.

Loneliness, social distance and avoiding crowd issues add another dimensions to our analysis i.e. store location - ONS regions (addressing the population density in the

neighbourhood) and size of the store. All these are important from the perspective of the subjective and emotional consumers' perception of the grocery shopping circumstances (e.g. Martin-Neuninger and Ruby 2020) and we check them with respect to the three devolved nations of the mainland UK. In the same context brand trust, connected with the store affiliation here, cannot be omitted in the analysis. Trust, priceless in times of uncertainty, is one of the major features for the customer and company relationships (Lien et al. 2015). It also refers to the positive belief of the customer on perceived product, services and the brand (Park and Kim 2016). Acknowledging this we test the affiliated and unaffiliated stores differences, all with respect to the three devolved nations of the mainland UK. A conceptual framework with the analysed independent and dependent variables presents figure 2.

These three countries are relatively small and underdeveloped in terms of their geographical size and population, geopolitical importance, market size and aggregate demand, production, investment, export, and technological potential. According to many non-economic indicators (political stability, democratization, liberalization and institutionalization of society, law, infrastructure development, safety, security, investment, compliance with environmental and social standards, efficiency of the legal system, human rights respect, etc.), as well as economic indicators (purchasing power, rate of economic growth, foreign trade balance, current account deficit, public debt, inflation rate, unemployment rate, public expenditure, investments, etc.), they are characterized by a long-term transitional crisis of structural type.

2. Methodological approach

2.1. Sample

Thanks to The Retail Data Partnership Ltd (TRDP) we use the unique dataset of the real life transactional data, drawn from a representative sample of 1,282 convenience stores (affiliated and unaffiliated) located in the mainland UK. TRDP has worked with retailers for more than 20 years to help them improve their business by developing ShopMate, the convenience sector's most dependable Electronic Point of Sale (EPoS) system. The majority of the analysed stores is located in England (984), 13.6% of them function in Wales (175) and the rest of the group operates in Scotland (123). Table 1 presents further details concerning the sample structure i.e. affiliation, location with respect to ONS region and store size.

We analyse the period of 36 months, starting from January 2018 till December 2020. We differentiate two periods in our investigation: pre-pandemic (Jan 2018 – Feb 2020) and pandemic period (March 2020 – Dec 2020). Our primary dataset consists of 778,305 transactional observations (one observation is one sales category in a given convenience store in a given month). We aggregate these categories and calculate percentage share of the number of single basket transactions in all recorded transactions as well as the average basket spend for each of 1282 convenience stores in each of 36 months under analysis. This way we obtain a balanced panel of 45,152 observations (1282 convenience stores in the period of 36 months – the same number of observations every month). In our research we use the dedicated software (Stata 15). Table 2 shows the descriptive statistics of the analysed indicators/characteristics of the purchase habits and routines (percentage share of the number of single basket transactions in all recorded transactions, the average basket spend).

Table 1. Characteristics of the analysed convenience stores

Description		**Percentage share in the overall number (1282 stores)**
Location		
	England	76.8%
	Scotland	9.6%
	Wales	13.6%
Affiliation		
	Affiliated	74.1%
	Unaffiliated	25.9%
Office for National Statistics (ONS) regions		
	Town and Fringe	13.7%
	Town and Fringe Sparse	1.5%
	Urban Larger	68.6%
	Urban Smaller	6.3%
	Villages and Remote Rural	9.9%
Store Size		
	Large	11.3%
	Medium	83.0%
	Small	5.7%

Source: Authors' own upon data of The Retail Data Partnership Ltd.

2.2. Data analysis

To achieve our goals and test the formulated hypotheses we run six random effects models (two for Scotland, two for England, two for Wales) widening our understanding of correlations between our dependent variables (percentage share of single basket transactions in the number of all recorded transactions and average basket spend) and various explanatory variables (time, location with respect to ONS regions, affiliation, and store size). Since the explanatory variables are binary we run random effects models (Cameron and Trivedi 2005). Moreover the Breusch and Pagan Lagrangian Multiplier Test for Random Effects (Breusch and Pagan 1980) is performed. Each time the null hypothesis (that there are no random effects between subjects) is rejected. This indicates the necessity to estimate the parameters of the random effects model.

This decision is also supported by the analysis of the interclass correlation. In all estimated models rho (fraction of variance due to u_i) coefficient equals more than 80%. Additionally stationarity of the dependent variables is tested. We work on the balanced panels (i.e. the same number of observations every month) therefore the Harris-Tzavalis test is applied. The null hypothesis that the analysed data has a unit root is rejected. Thus the procedure confirmed that the dependent variables are stationary.

Table 2. Descriptive statistics of three analysed indicators/characteristics of purchase habits and routines

Description		Share of single basket transactions in the number of all recorded transactions (%)			The average basket spend (£)		
		England	Scotland	Wales	England	Scotland	Wales
Number of observations	total period	35424	4428	6300	35424	4428	6300
	pre-pandemic	25584	3198	4550	25584	3198	4550
	pandemic	9840	1230	1750	9840	1230	1750
mean	total period	19.901	18.635	18.499	6.832	6.920	6.768
	pre-pandemic	21.454	19.966	20.091	6.262	6.267	6.118
	pandemic	15.866	15.175	14.359	8.315	8.618	8.458
Percentile 25	total period	14.988	14.019	14.542	5.569	5.613	5.602
	pre-pandemic	16.832	15.622	16.507	5.312	5.379	5.264
	pandemic	11.475	10.665	11.241	7.124	7.251	7.314
Percentile 50	total period	18.835	17.681	17.997	6.492	6.561	6.517
	pre-pandemic	20.172	18.629	19.310	6.038	6.105	6.079
	pandemic	14.603	14.050	13.760	8.077	8.306	8.291
Percentile 75	total period	23.338	21.799	21.464	7.723	7.782	7.668
	pre-pandemic	24.479	22.595	22.533	6.923	6.927	6.862
	pandemic	18.656	17.706	16.734	9.139	9.392	9.311
minimum	total period	1.471	2.257	1.464	2.581	3.189	3.457
	pre-pandemic	3.580	3.694	7.695	2.581	3.189	3.457
	pandemic	1.471	2.257	1.464	3.840	3.990	4.785
maximum	total period	61.391	42.900	48.879	28.854	36.065	28.836
	pre-pandemic	61.391	42.900	48.879	26.738	16.683	10.696
	pandemic	57.484	41.217	41.988	28.854	36.065	28.836
Standard deviation	total period	7.558	7.053	6.063	1.990	2.112	1.708
	pre-pandemic	7.297	6.733	5.699	1.657	1.449	1.133
	pandemic	6.685	6.685	4.915	2.020	2.571	1.792

Source: Authors' own upon data of The Retail Data Partnership Ltd.

Reference time period starts in January 2018 and finishes in February 2020 (pre-pandemic), reference stores are affiliated, reference Office for National Statistics location is urban larger (following the ONS Rural/Urban Classifications (ONS 2021)) and reference store size is medium (average turnover in this store is more than 0.5 and less than 1.5 of average turnover for all analysed stores and the number of tills equals 1 or 2).

3. Conducting research and results

3.1. Single item purchase behaviour in the grocery sector in the era of Covid-19

The first hypothesis (H1) addresses the single item purchase behaviour in the grocery sector. For that reason we commence our analysis with changes in time of the percentage share of single basket transactions in the number of all recorded transactions among three analysed devolved nations. The graphical visualisation of the average value of percentage share of single basket transactions in the number of all recorded transactions from January 2018 to December 2020 in England, Scotland and Wales presents figure 3.

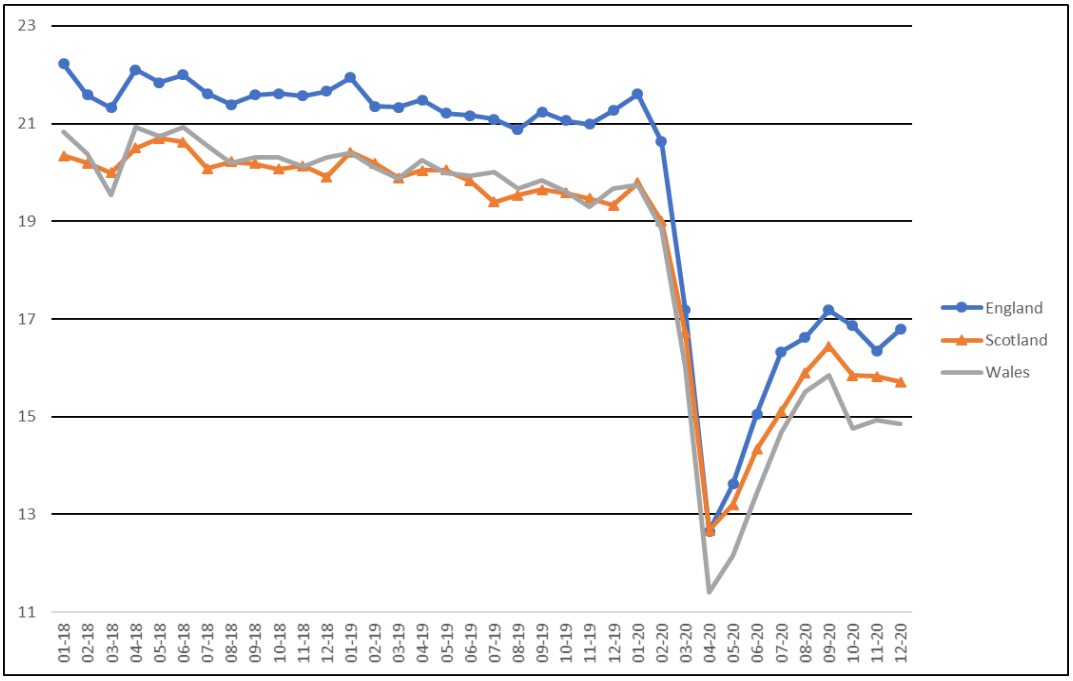

Figure 3. The graphical visualisation of the average value of percentage share of single basket transactions in the number of all recorded transactions from January 2018 to December 2020 in England, Scotland and Wales (%).
Source: Authors' own upon data of The Retail Data Partnership Ltd.

The percentage share of single basket transactions in the number of all recorded transactions is the dependent variable of the first group of three random effects models (Table 3). Our models show that percentage share of single basket transactions in the number of all recorded transactions across England, Scotland and Wales is consistently lower in the analysed pandemic period than in the pre-pandemic one, given the same levels of our control variables (location in terms of ONS region, affiliation, store size).

The highest drop of the percentage share of single basket transactions in the number of all recorded transactions for all three nations is observed in April 2020. The coefficients equal -8.795, -7.290 and -8.679 for England, Scotland and Wales respectively. It means that in April 2020 the percentage share of single basket transactions is on average lower by -8.795, -7.290 and -8.679 percentage points than in the pre-pandemic period in England, Scotland and Wales respectively. Subsequently the drop slightly shrinks and it is a consistent trend across three nations. October 2020 reveals the breaking point in the observed trend across three nations and the share of single basket transactions in the number of all recorded transactions decreases again (the highest coefficient difference between September and October 2020 equals 1.081 in the case of Wales). Fourth quarter of 2020 shows different dynamics of shifts across three devolved nations with the lowest share of single basket transactions in the number of all recorded transactions in November in England (coefficient equals -5.101, in December in Scotland (coefficient equals -4.258) and in October in Wales (coefficient equals -5.329). Overall, the percentage share of single basket transactions is substantially lower in the analysed pandemic months (March - December 2020) than in the pre-pandemic period in all three nations (all time period coefficients are statistically significant at the 1% level).

Table 3. Random effects models of percentage share of single basket transactions in the number of all recorded transactions as the dependent variable in England, Scotland and Wales.

Independent Variable	England		Scotland		Wales	
	Coefficient	p>|t|	Coefficient	p>|t|	Coefficient	p>|t|
March 2020	-4.269	0.000***	-3.255	0.000***	-4.082	0.000***
April 2020	-8.795	0.000***	-7.290	0.000***	-8.679	0.000***
May 2020	-7.827	0.000***	-6.765	0.000***	-7.931	0.000***
June 2020	-6.400	0.000***	-5.634	0.000***	-6.653	0.000***
July 2020	-5.126	0.000***	-4.854	0.000***	-5.415	0.000***
August 2020	-4.829	0.000***	-4.067	0.000***	-4.586	0.000***
September 2020	-4.273	0.000***	-3.523	0.000***	-4.248	0.000***
October 2020	-4.592	0.000***	-4.124	0.000***	-5.329	0.000***
November 2020	-5.101	0.000***	-4.140	0.000***	-5.160	0.000***
December 2020	-4.666	0.000***	-4.258	0.000***	-5.237	0.000***
Town and Fringe (ONS region)	-2.629	0.000***	-4.000	0.003***	-2.308	0.005***
Town and Fringe Sparse (ONS region)	1.327	0.609	-1.647	0.339	1.255	0.518
Urban Smaller (ONS region)	-0.647	0.455	-0.449	0.740	0.968	0.865
Villages and Remote Rural (ONS region)	-6.869	0.000***	-6.303	0.000***	-6.038	0.000***
Small (store size)	4.672	0.000***	5.235	0.167	-0.744	0.658
Large (store size)	-2.157	0.000***	-0.952	0.569	-2.327	0.003***
Unaffiliated (independent stores)	3.131	0.000***	4.235	0.021**	1.722	0.049**
constant	21.444	0.000***	21.320	0.000***	21.055	0.000***
R-sq within		0.677		0.648		0.767
R-sq between		0.165		0.2732		0.162
R-sq overall		0.256		0.3321		0.316
Prob > chi2		0.000		0.000		0.000
Rho (fraction of variance due to u_i)		0.921		0.920		0.914
Number of observations		35,424		4,428		6,300
Number of stores		984		123		175

Notes: *** Statistical significance at the 1% level.
** Statistical significance at the 5% level.
* Statistical significance at the 10% level.
Reference categories are: pre-pandemic period (January 2018 - February 2020), urban larger ONS region, medium store size, affiliated stores.
Source: Authors' own upon data of The Retail Data Partnership Ltd.

In terms of ONS region (Table 3) the only statistically significant results across three nations are obtained for Town and Fringe as well as Villages and Remote Rural regions. In both cases the average percentage share of single basket transactions in the number of all recorded transactions are smaller than in the Urban Larger ONS region, all other factors being equal. While the smallest coefficients (-6.869, -6.303 and -6.038, for England, Scotland and Wales respectively) are noted for the Villages and Remote Rural ONS region, the highest coefficient differences across nations are observed in the context of Town and Fringe ONS region.

Analysis of further independent variables being stores characteristics (Table 3) shows that store size brings statistically significant results for all categories at the 1% level in the case of England, whereas Scotland does not provide statistically significant results and Wales provides statistically significant results only for large stores. In small stores in England the mean of percentage share of single basket transactions in the number of all recorded transactions is higher than in medium stores and in big stores it is lower than in medium ones (coefficients equal 4.672 and -2.157 respectively). Affiliation analysis brings statistically significant results for all three nations (Table 3) and our model shows that the mean of percentage share of single basket transactions in the number of all recorded transactions in independent convenience stores is higher than in the affiliated ones (but the coefficients hugely vary between nations).

3.2. Average basket spend on grocery shopping in the era of Covid-19

The second hypothesis (H2) addresses the average basket spend on grocery shopping in the era of Covid-19. Consequently, analysis of this section begins with changes in time of this variable and its graphical visualisation. We concentrate on the period of 36 months (from January 2018 to December 2020) in England, Scotland and Wales, as shows Figure 4.

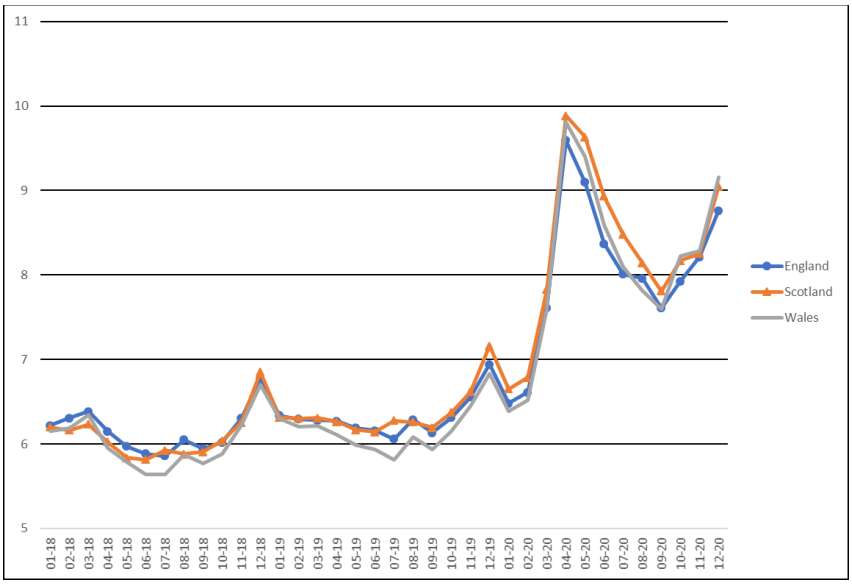

Figure 4. The graphical visualisation of the average basket spend mean value from January 2018 to December 2020 in England, Scotland and Wales (£).

Source: Authors' own upon data of The Retail Data Partnership Ltd.

Three further random effects models are estimated for average basket spend as the dependent variable in England, Scotland and Wales. Table 4 shows that the average basket spend is consistently higher in the analysed pandemic period than in the pre-pandemic one in all three nations. The highest coefficients are observed in April (at a very similar level for all three nations i.e. 3.332 in England, 3.620 in Scotland, and 3.690 in Wales). From May to September 2020 the average basket spend gradually decreases in three devolved nations (the extent of the changes differ though). The breaking point for this trend takes place in October 2020 when the coefficients increase in all analysed models. Coefficients of November and December 2020 show that the growing trend is continued in three nations but again the dynamics varies. In England the difference observed between November's and December's

coefficients is twice as much as between October and November. In Wales the difference is very small between October's and November's coefficients (0.058) whereas the following month it is 0.87 and in Scotland the situation is similar (0.082 between October and November and 0.799 between November and December). Overall, the average basket spend is substantially higher in the analysed pandemic months (March - December 2020) than in the pre-pandemic period in all three nations (all time period coefficients are statistically significant at the 1% level).

ONS regions analysis in our models (Table 4) reveals inconsistences across three nations in statistical significance of results. While the only statistically significant results for England and Scotland are obtained in the case of Town and Fringe Sparse (coefficients equal -1.016 and 1.834 respectively) and Villages and Remote Rural (coefficients equal 0.304 and 0.984 respectively), for Wales they appear in the case of Town and Fringe (coefficient equals -0.343) and Urban smaller (coefficient equals -1.204). Further independent variables being stores characteristics demonstrate that store size brings statistically significant results for all categories (at different levels) in the model for England, no statistically significant results for Scotland and only that of large stores for Wales is statistically significant. Analysis of affiliation provides statistically significant results only in the case of England, where average basket spend is higher in the unaffiliated stores than in the affiliated ones (coefficient equals 0.308).

Table 4. Random effects models of average basket spend as the dependent variable in England, Scotland and Wales

Independent Variable	**England**		**Scotland**		**Wales**	
	Coefficient	**p>|t|**	**Coefficient**	**p>|t|**	**Coefficient**	**p>|t|**
March 2020	1.350	0.000***	1.559	0.000***	1.477	0.000***
April 2020	3.332	0.000***	3.620	0.000***	3.690	0.000***
May 2020	2.837	0.000***	3.367	0.000***	3.283	0.000***
June 2020	2.108	0.000***	2.664	0.000***	2.470	0.000***
July 2020	1.747	0.000***	2.212	0.000***	1.981	0.000***
August 2020	1.700	0.000***	1.878	0.000***	1.696	0.000***
September 2020	1.347	0.000***	1.541	0.000***	1.483	0.000***
October 2020	1.665	0.000***	1.903	0.000***	2.111	0.000***
November 2020	1.950	0.000***	1.985	0.000***	2.169	0.000***
December 2020	2.499	0.000***	2.784	0.000***	3.039	0.000***
Town and Fringe (ONS region)	0.173	0.391	0.441	0.082	-0.343	0.089*
Town and Fringe Sparse (ONS region)	-1.016	0.006***	1.834	0.001***	-0.583	0.205
Urban Smaller (ONS region)	-0.093	0.705	0.383	0.199	-1.204	0.000***
Villages and Remote Rural (ONS region)	0.304	0.036**	0.984	0.028**	0.496	0.155
Small (store size)	-0.970	0.000***	0.063	0.888	-0.224	0.704
Large (store size)	0.503	0.016**	0.079	0.798	0.328	0.078*
Unaffiliated (independent stores)	0.308	0.050**	-0.257	0.557	-0.169	0.327
constant	6.153	0.000***	5.856	0.000***	6.160	0.000***
R-sq within		0.712		0.627		0.752
R-sq between		0.046		0.081		0.084
R-sq overall		0.271		0.324		0.464
Prob > chi2		0.000		0.000		0.000
Rho (fraction of variance due to u_i)		0.863		0.760		0.738
Number of observations		35,424		4,428		6,300
Number of stores		984		123		175

Notes: *** Statistical significance at the 1% level.
** Statistical significance at the 5% level.
* Statistical significance at the 10% level.
Reference categories are: pre-pandemic period (January 2018 - February 2020), urban larger ONS region, medium store size, affiliated stores.
Source: Authors' own upon data of The Retail Data Partnership Ltd.

3.3. Stringency index context

We contextualise all these findings within the stringency index in the period between March and December 2020. For that reason we calculate the monthly average stringency index for all three devolved nations of the mainland UK. Subsequently we assess the Pearson correlation coefficients for stringency index and (a) shifts in the share of single basket transactions as well as (b) shifts in the average basket spend (as measured by the time coefficients in the panel data models revealed in table 3 and table 4 respectively). The obtained correlation coefficients are statistically significant (at minimum 5% level), with the only exception for England's share of single basket transactions coefficient. The results show that the direction of the correlation is the same for all analysed nations but the strength of the correlation varies (Table 5).

Table 5. Correlation between Month Average Stringency Index and the time coefficients of the share of single basket transactions and average basket spend, all between March-December 2020 (table 3 and table 4) across three devolved nations of the mainland UK.

	England		**Scotland**		**Wales**	
	Share of single basket transactions	**Average basket spend**	**Share of single basket transactions**	**Average basket spend**	**Share of single basket transactions**	**Average basket spend**
Correlation Coefficient	-0.483	0.636**	-0.732**	0.716***	-0.673**	0.763**

Notes: *** Statistical significance at the 1% level.
** Statistical significance at the 5% level.
* Statistical significance at the 10% level.
Source: Authors' own upon data of The Retail Data Partnership Ltd. and data of Blavatnik School of Government, University of Oxford.

4. Discussion and conclusions

Research implications

Our research not only supports the claim of the impact of Covid-19 on grocery shopping behaviour (e.g. Grashuis, Skevas, and Segovia 2020; Martin-Neuninger and Ruby 2020, Sheth 2020) but, more importantly, it reveals further dimensions of these implications across three devolved nations of the mainland UK. Our analysis let us positively verify both of the formulated hypotheses (H1 and H2). We show, though, that despite the observed consistent tendencies of the behaviour shifts across England, Scotland and Wales, there are some differences in the dynamics.

All devolved nations reacted consistently on the government stay-at-home orders and other pandemic restrictions i.e. with limiting the single item purchase and spending more during one visit in the convenience store. What is more, at times when the English, Scottish and Welsh

governments introduce the same/similar orders (i.e. the stringency index does not vary a lot between them) the average basket spend and the percentage share of single basket transactions in all recorded grocery shopping transactions keep very close dynamics (e.g. April 2020 brings the highest dynamics in all three devolved nations in both analysed aspects of the grocery shopping behaviour). Meaningfully, May 2020 is the beginning of period when the stringency index varies a lot between the three analysed nations. Unsurprisingly, this is also the beginning of the period when various inconsistencies between the dynamic in England, Scotland and Wales can be observed in the calculated models. Those interdependencies are easier to note in the context of single basket purchase behaviour. In the last quartile of the year 2020 the single basket purchases shifts are the most dynamic in the case of Wales (simultaneously with the highest stringency index (figure 1)). Whereas the situation is the most stable in Scotland (the most stable stringency index (figure 1)), in England the dynamics increases in November and then decreases again (just like the stringency index (figure 1)). Such observations appear also in the context of the average basket spend but are more ambiguous. These detailed conclusions need further clarification (beyond the convenience sector) but overall tendency proves the meaning of the governmental recommendations in the field of health security for the grocery shopping behaviour. This confirms the significance of the pro-active approach of the decision-makers implementing the corresponding regulations.

Interestingly, additional explanatory variables analysis provides further reasons to emphasise differences among the three analysed devolved nations (the differences appear not only between the coefficients levels but also the statistical significance of the obtained results). Such an observation supports the claim of the need to understand and address the devolved nations not only as the components of the UK but also individually (Hallsworth and Coca-Stefaniak 2018; Moffatt et al. 2012), including the context of the Covid-19 pandemic.

Managerial implications

Overall our research supports the claim that managers need to foresee disruptions, including the consumer shopping behaviour shifts, resulting from such circumstances like widely understood economic and health crisis. Covid-19 pandemic shows the significance of flexibility and adaptability to turbulent conditions, especially in the context of grocery shopping and convenience store sector. Sector resilience and resilience of singular businesses within the sector of convenience stores are nowadays increasingly often connected with the local community and economy resilience (e.g. Rybaczewska & Sparks, 2020).

Specific aspects of our study reveal that within the pandemic circumstances footfall is no longer the strong prognostic for turnover and consequently the business resilience in the context of convenience stores sector. We show that when customers come to the store in the era of Covid-19 they far less often buy one item and spend far more on the average basket than before pandemic. Moreover we reveal that store size in England is far stronger correlated with consumers' one item purchase behaviour and average basket spend than in Scotland and Wales. In other words store size is the most consequential in the context of England. It is important for stores' managers in all three analysed devolved nations to prepare their businesses to cope with larger spend/larger amount of products bought at one time by one customer. Sometimes longer sliding belts at checkouts are needed, sometimes just more self-checkouts etc. Pro-active approach of the managers is needed here. This underpins the meaning of our results increasing the managers' awareness of new opportunities and challenges for their businesses.

Interestingly, we show also that the consumers' reaction to the first lockdown was consistently stronger than to the forthcoming restrictions. Therefore, significantly for managers

and policy-makers, our research provides the additional dimension of the claim of shock and threat influence on consumers' behaviour (Campbell et al. 2020; Schmidt et al. 2021).

Our research shows that affiliation consistently influences the consumers' shopping behaviour across three analysed devolved nations in the context of single item purchase behaviour (customers more often purchase one item in the unaffiliated stores than in the affiliated ones). This corresponds, among others, with the brand trust and loyalty (e.g. Atulkar 2020; Chaudhuri & Holbrook, 2001). Most importantly, it proves that affiliation is about far more than just business everyday functioning in the conveniense store sector, especially in times of uncertaintity. In the context of average basket spend, though, the results are inconsistent across England, Scotland and Wales. The only statistically significant results are obtained for England so managers can believe that the meaning of affiliation from the consumers' behaviour angle is higher there than in Scotland or Wales (in England average spend is lower in the unaffiliated stores than in the affiliated ones).

We also reveal that store location in terms of ONS region is not always significant in the context of consumer behaviour shifts in the era of Covid-19. Anecdotal evidence shows that this determinant is often overestimated by managers and underestimated by policymakers. In our reasoning we explicitly address the pandemic circumstances only.

Limitations and future research

Among the limitations of our study we realise some technical issues and possible human mistakes (transactional data). We were not involved in the process of reaching the stores to receive the data. Consequently, we did not control the procedure of reporting the specific transaction/product category and had no chance to train/support the retailers while sharing their records. Nevertheless this process was almost fully automated and The Retail Data Partnership provided the needed support to retailers. Consequently, we have the access to the dataset being very consistent (thanks to The Retail Data Partnership Ltd.). Additionally, to maximise the credibility of our analysis, we aggregated the product categories in our data (balanced panels).

In the future we intend to broaden our investigation by expanding the timescale in our panel data. Such approach will reveal which shifts in grocery shopping behaviour observed in times of Covid-19 are permanent (Hesham, Riadh, and Sihem 2021; Sheth 2020). Moreover such study will provide the comparisons between first consumers' reactions (March-April 2020) and their reactions to forthcoming restrictions and lockdowns implemented in the following months/years. We aim also to expand our analysis of additional explanatory variable (besides location, store size and affiliation) to build more in-depth understanding of the addressed issues.

Conclusions

Whereas grocery shopping has been investigated by many authors from various angles, the literature explicitly claims that there is still a need for further exploration (e.g. Morganosky and Cude 2000; Shaw and Alexander 2008). The unprecedented circumstances of Covid-19 brought particular reason for us to conduct this investigation since many authors have already showed the influence of pandemic on consumers' behaviour (e.g. Martin-Neuninger and Ruby 2020). To the best of our knowledge this is the first attempt to address the consistencies and inconsistencies between the grocery shopping behaviour shifts in the era of Covid-19 across three devolved nations of the mainland UK. We address also the strictness of 'lockdown style' closure and containment policies that primarily restrict people's behaviour (stringency index).

We use a unique dataset of transactional data (778,305 observations) drawn from 1,282 convenience stores located in England, Scotland and Wales (thanks to The Retail Data Partnership Ltd). Random-effects models applied to our longitudinal data address particular aspects of purchase behaviour (one item transactions, average spend per transaction) in the pre-pandemic (Jan 2018 – Feb 2020) and pandemic period (March 2020 – Dec 2020).

We disclose that, despite the consistent decrease of single item transactions and increase of average spend per transaction across England, Scotland and Wales, the dynamics of these shifts in time varies meaningfully. All these shifts highly correlate with the stringency index. Analysis of additional explanatory variables i.e. store size, location, affiliation shows further dimensions. Whereas affiliation is consistently meaningful across England, Scotland and Wales, store size correlates with single item transactions and average spend per transaction mainly in England, and the significance of location in terms of ONS region is, unexpectedly, inconsistent.

Various extensive theoretical and managerial implications of this study confirm its contribution and novelty not only from the point of view of the long-term process of knowledge building in the field of grocery shopping behaviour but also business practice within the convenience store sector.

Acknowledgement

We would like to thank The Retail Data Partnership Ltd. Their priceless contribution included, among others, providing us the access to the analysed dataset. Without their openness to assist this paper would never be written.

We also highly appreciate the contribution of the Blavatnik School of Government, University of Oxford and all co-authors of the working paper 'Variation in the response to COVID-19 across the four nations of the United Kingdom' for their willingness to share their data with us.

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