Comparative Economic Research, Volume 19, Number 4, 2016
10.1515/cer-2016-0031

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Comparative Study Of The Role Of Institutions In Shaping Inventive Activity In Mid-Range Emerging Economies[1]

Abstract

The objective of this paper is to investigate the effects of institutions on national rates of inventive activity. Invention, part of the innovation process, is acknowledged as one of the driving forces behind economic growth, and patent statistics are frequently used as a measurable indicator of inventive output. Thus this paper explores the relationship between national patent statistics and measures of institutional quality. As a result of our research, the effect of the "threshold of inventive activity" was observed. This effect demonstrates that when countries reach a certain level of institutional development and attain a general institutional climate conducive to inventive activity, the number of patent applications begins to sharply increase. The paper contributes to the body of evidence that confirms that a combination of fundamental institutions like the rule of law or freedom of expression, which are not necessarily aimed at boosting innovation, create an overall environment conducive to patenting. We demonstrate that "mid-range emerging economies",[2] including those in Central and Eastern

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[1] The contribution to this paper by Malgorzata Zmuda is funded by National Science Centre, Poland (project: 2015/17/B/HS4/02075).

[2] Mid-range emerging economies are economies that moved beyond an emerging status with regard to economic, institutional, as well as infrastructure development and are positioned between emerging and developed economies (Hoskisson, Wright, Filatotchev, and Peng 2013). The terms "emerging" or "developing" economies are used interchangeably. We also use the term "transitional economy" as applied to the former Soviet Union and the former socialist satellite states in Eastern Europe.

Europe[3] (CEE), where the quality of institutions is lagging behind more developed counterparts and/or their influence is weak or sporadic, have not yet reached the threshold of inventive activity yet. However, those CEE countries that have acceded to the European Union first have made visible progress with respect to institutional quality and invention.

***Keywords**: innovation, patent statistics, inventive activity, institutions, institutional quality*

1. Introduction

Both institutions and innovation are credited with the power to prompt economic growth. In principle, every country should work on forming and fostering an institutional infrastructure conducive to economic activities and an active innovation scene, leading to an increase in productivity. The role of institutions in promoting technical change has been extensively discussed in the economic and political economy literature, but the question of this association keeps coming to the foreground, partly because it addresses the practical issue of building a national innovation base. The geopolitical changes in the last two decades, namely the collapse of the centrally-planned economies in the former Soviet Union and in Central and Eastern Europe (CEE), as well as the economic transformation of China and India, and the subsequent challenges of institutional restructuring highlight the continued importance of addressing this question. More empirical, cross-country research is needed to examine the effects of institutions on technical change (Tebaldi and Elmslie 2013, p. 887).

Following the footsteps of scholars who have focused on the relationship between institutions and innovation (Cvetanovic and Sredojevic 2012; Huang and Xu 1999; Taylor 2009; Tebaldi and Elmslie 2008; van Waarden 2001), this paper constitutes an exploratory attempt to look at the effects of institutions on patent data as a measure of inventive activity. Mid-range emerging economies offer

[3] For the purposes of this project, the list of the CEE economies includes the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic, and Slovenia. This definition can be found in the Organization for Economic Co-operation and Development (OECD) Glossary of Statistical Terms at https://stats.oecd.org/glossary/detail.asp?ID=303. In addition to this category of the Central and Eastern European Countries (CEECs), we also added Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Macedonia, and Romania. The reasons behind including these southern Central European economies into the group of the CEECs are not based on the logic of geography, but rather to emphasize their ties with the European Union (EU) and the fact that they are on the list of the 60 "mid-range emerging economies" in Hoskisson et al (2013).

a conceptually different institutional environment than developed economies. For example, the CEE economies, which were pressed to undergo "radical systemic transformation" (Cieslik and Kaciak 2009) in order to meet the requirements of prospective membership in the European Union, are the products of institutional experimentation and thus contain valuable insights into the link between institutions and invention.

1.1. Patents as Measure of Inventive Activity

Innovation has been described as a process with three overlapping stages: invention, innovation, and diffusion. Invention implies creating a new idea. Then through the process of innovation the idea acquires a usable form, for example, it turns into a new product, while diffusion refers to producing and marketing this new product (King, Gurbaxani, Kraemer, McFarlan, Roman and Yap 1994, p. 140). Patents are usually associated with the first stage of innovation; however, as Lamoreaux and Sokoloff (1996) comment, the establishment of a patent system not only encourages inventive activity in countries like the US, but also promotes the spread of technological knowledge and increased productivity. Thus patenting is an integral part of technological development.

Joseph Schumpeter (1952) stressed the importance of technological development for economic competition, whereas Abramovitz (1956), Kendrick (1956), and Solow (1957) highlighted the "residual" effect of "technical change" as a source of productivity. Higher productivity, i.e. "the value of the output produced by a unit of labor or capital" results in improved national competiveness (Porter 1990). A number of scholars have focused on the relationship between competitiveness and patent statistics as a measure of technical change (Dosi, Pavitt, and Soete 1990; Jaffe and Trajtenberg 2002; Pavitt and Soete 1980; Scherer 1992; Sood and DuBois 1995). Thus inventive activity by domestic firms is part of the efforts to increase national productivity and competitiveness. Economists, operating at the macro level, treat patent data as an indicator of inventive output.[4]

[4] The use of patent statistics as a proxy for inventive activity (including the problems associated with this data source) has been extensively discussed in Comanor and Scherer (1969), Griliches (1990), Kuznets (1962), Mueller (1966), Schmookler (1966), Schmookler and Brownlee (1962).

1.2. Institutions and Invention

Discrepancies in national economic performances have been attributed not only to techno logy advances, but also to the role of domestic political and economic institutions. The insights of Douglas North (North 1990, 1991; North and Thomas 1973) on formal and informal institutions[5] determining the pace of economic development have inspired a diverse body of literature. Elaborate econometric models and empirical studies acknowledge the relationship between institutions and economic growth (Acemoglu, Johnson and Robinson 2001; Barro 1996; Glaeser, La Porta, Lopez-de-Silanes and Schleifer 2004; Hall and Jones 1999; Knack and Keefer 1995). Chong and Calderon (2000) and Gradstein (2003) highlight the mutually reinforcing relationship and argue that good institutions promote growth, which in turn leads to a better quality of institutions.

Coherent bureaucratic machinery, a source of rational-legal legitimacy in Weber's *Politics as a Vocation* (1946), cultivates business development through "instrumental rationality and activism" (Rueschemeyer and Evans 1985, p. 50). The "developmental state" literature explored the role of the state in industrial development, especially in the countries that industrialized late like, for example, Japan or South Korea (Johnson 1982; Amsden 1985, 1989; Cumings 1999; Woo-Cumings 1999). Approaches to measuring institutional quality vary. Acemoglu, Johnson, Robinson, and Yared (2008), Rodrik, Subramanian, and Trebbi (2004), and Przeworski (2004) emphasize the role of democratic institutions in economic growth. According to Davis (2010), institutional flexibility plays a critical role in boosting economic development. The role of cultural factors has been discussed in Easterly and Levine (2003), Engerman and Sokoloff (1997), and Mauro (1995).

Polanyi (1944) opened a discussion on the embedded relationships between the market and sociopolitical institutions in Europe during industrialization. Those political economists who stress the political embeddedness of an enterprise focus on elites, corruption and other formal and informal institutions that affect business operations (Fields 1995). Evans explored the concept of "embedded autonomy", when the combined efforts of bureaucracy and private actors stimulate industrial growth (1992, p. 165; 1995). Inspired by the discussions of the strategic role of the state in the industrialization process and the social embeddedness of economic

[5] In his article surveying growth literature in the final 15 years of the last century, Sala-i-Martin provides a comprehensive definition of institutions (2001, p. 17). Separate elements or groups of elements of this definition were quantified and served in various econometric models.

actors, the "national system of innovation"[6] literature focused on the interactions between public and private actors in an effort to innovate (Freeman 1995; Nelson 1993).

1.3. Institutions and Invention in Emerging Economies

Interest in the effects of institutions is shared by the entrepreneurship literature. Entrepreneurship scholars pay distinct attention to the role of the formal and informal institutional make-up of home markets in affecting the behavior of small and medium-sized enterprises (SMEs) (Ahlstrom and Bruton 2010; Descotes, Walliser, and Guo 2007; Hoskisson, Wright, Filatotchev, and Peng 2013; Lu, Tsang and Peng 2008; Yamakawa, Peng, and Deeds 2008). These scholars provide a body of evidence showing that institutional quality shapes the rate of innovation, internationalization, or other strategic decisions pursued by SMEs.

Developing and mid-range emerging economies are contextually different from mature economies and tend to have weak regulatory institutions, as well as social and normative institutions that might not be supportive of entrepreneurship (Ahlstrom and Bruton 2010; Shirokova and McDougall-Covin 2012; Shirokova and Tzukanova 2012). Zhu, Wittmann and Peng (2012), in their investigation of institutional barriers to innovation by SMEs in China, called for more research into the factors affecting innovation in emerging economies. Since SMEs are small and lack resources, their engagement in innovation is inherently risky and they require more nurturing in the form of "market-supporting, entrepreneur-friendly institutions" (Zhu et al 2012, p. 1140). Thus a poor institutional infrastructure, such as a lack of intellectual property (IP) rights protection or high levels of corruption, should lead to a decline in invention.

1.4. Institutions and Invention in Central and Eastern Europe

The institutional perspective has been a logical choice for many entrepreneurship scholars interested in the internationalization strategies of SMEs from the transition economies in Eastern Europe and the former republics of the

[6] In his survey of the literature on national innovation systems, Carlsson defines a "national system of innovation" as a set of "distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process" (Carlsson 2006, p. 58; Metcalfe 1997, p. 289).

Soviet Union. Because of the abrupt change in the regulatory framework, a new environment emerged and led to the birth of millions of new internationally active businesses (Cieslik and Kaciak 2009, p. 383). However, this new regulatory environment discouraged innovation because of high levels of uncertainty, which was an accompanying feature of the transition process (Sára, Csedő, Fejes,Tóth, Pörzse 2013, p. 49). Nevertheless, the new members of the EU from CEE have made significant progress economically and politically in catching up with the rest of the EU. Admittedly, at the beginning of the century the upcoming EU membership was a key determinant shaping the national approaches to innovation systems in the Central and Eastern European Countries (CEECs) (Dolinšek and Poglajen 2009). Based on the logic that improvements in the quality of institutions would lead to an increase in patenting activity, the CEECs present a unique opportunity to look at invention in the context of emerging economies.

2. Methodology

This project examined the association between patent statistics (from the World International Patent Organization (WIPO) Statistics Database) and measures of institutional quality. The purpose of this cross-country comparison was to gain empirical insights into the relationship between institutions and patent statistics as a proxy for inventive activity. The assumption that institutional effects on inventive output are especially evident in emerging economies, where a poor quality of institutions make strategic decisions like invention or internationalization inherently risky, was tested by looking closer at the link between institutions and the so-called "mid-range emerging"[7] economies based on the selection criteria suggested in Hoskisson et al (2013).

2.1. Operationalization of Institutional Quality

There is a diversity of measurable indicators of institutional quality, which are publicly available and regularly updated.[8] For instance, Gradstein (2003) looked at the relationship between income per capita and different measures of governance quality, operationalized by the Worldwide Governance Indicators (WGIs). This paper used the WGI percentile ranks and the Distance to Frontier

[7] Most transitioning economies in Eastern Europe or the former republics of the Soviet Union belong to the category of "mid-range emerging" economies.

[8] See the exhaustive list of institutional and IP indices at Taylor Wessing: http://www.taylorwessing.com/ipindex/instrumental_factors.html (accessed on March 10, 2015).

(DTF) scores of the Doing Business Index elaborated by the World Bank. The choice of these two sources of institutional measurements was dictated by their popularity in the economic literature, as well as their convenience of use, comprehensiveness, and comparable ranking outcomes.

The Worldwide Governance Indicators (WGIs) consist of six composite indicators of institutional quality covering over 200 countries.[9] Data sources include perceptions-based surveys of firms and households, as well as non-governmental organizations, international governmental organizations, country experts, and government agencies like the U.S. Department of State (Kaufmann, Kraay and Mastruzzi 2010). The WGIs report evaluates outcomes as a percentile rank on a scale from zero to 100, where zero stands for the lowest level of institutional quality. This project uses an averaged WGI rank of 182 countries for a period of four years (2010–2013).

The World Bank Doing Business index ranks economies on their ease of doing business.[10] The Distance to Frontier (DTF) score reflects the quality of the regulatory environment and its improvement over time and shows the distance of each economy to the "frontier", or best performance across all economies. A country's distance to frontier is reported on a scale from zero to 100, where zero represents the lowest performance. "When compared across years, the distance to frontier score shows how much the regulatory environment changed over time in absolute terms" (The World Bank, Distance to Frontier 2015, p. 146). This project uses an averaged Distance to Frontier (DTF) score of 178 countries for the same period of four years (2010–2013).

2.2. Inventive Activity as Patent Statistics and Data Sources

The World Intellectual Property Organization (WIPO), a specialized agency of the United Nations, compiles patent statistics from national and regional IP offices and makes these data available on its website (http://www.wipo.int/ipstats). A patent is a set of exclusive rights granted to applicants for "inventions that are

[9] The indicators include "voice and accountability; political stability and absence of violence and terrorism; government effectiveness; regulatory quality; rule of law; and control of corruption." The WGI cross-country data, as well as a detailed description of its methodology, can be found on the World Bank website at http://info.worldbank.org/governance/wgi/index.aspx#doc

[10] The rankings cover ten topics: "starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency." The World Bank Distance to Frontier (DTF) scores for cross-country data, as well as a detailed description of its methodology, can be found on the World Bank Group website at http://www.doingbusiness.org/data/distance-to-frontier.

new, non-obvious and commercially applicable" for a period of 20 years.[11] In the WIPO patent database the origin of the application is determined by the country of residence of the first-named applicant on an IP application. This research project used the total number of applications granted by a national IP office to resident applicants as well as grants offered by foreign IP offices to resident applicants ("application abroad") between 2010 and 2013.[12] Because patent data are subject to random fluctuations, Mueller recommends using averaged patent figures over a span of 3–5 years (1966, p. 36). Thus the number of patents granted over a four-year period was averaged, adjusted for population (per million) and GDP (per billion US dollars), and correlated with averages of two sets of institutional factors: the World Governance Indicators (WGIs) developed by Kaufmann et al (2010) and the Distance to Frontier score of the World Bank Doing Business Index.[13]

3. Data Analysis

3.1. Institutional Quality and Patenting

The average number of applications (adjusted for population and GDP) granted to residents from WIPO member-countries between 2010 and 2013 was correlated with two sets of institutional factors: WGI and DTF. The Pearson correlation coefficients in Table 1 point to a moderately strong relationship between institutions and inventive activity.[14] These results support the findings in Tebaldi and Elmslie (2013, p. 892) presented in Table 2. The stronger correlations in Tebaldi and Elmslie (2013) could be explained by a different combination of institutional variables and patent data, as well as the longer time span.[15]

[11] The full definition can be found on the WIPO website in the Glossary section at: http://www.wipo.int/ipstats/en/statistics/glossary.html (accessed on March 1, 2015).

[12] For exact definitions of "resident application" and "application abroad," please see the WIPO Glossary at: http://www.wipo.int/ipstats/en/help/ (accessed on March 7, 2015).

[13] We looked at detailed patent statistics (number of patents granted to residents domestically and from abroad for the period 2003 to 2013 in 188 countries, WIPO Statistics Database) and identified no discernable pattern with respect to the annual growth rate in the numbers of granted patents being affected by the world financial crisis (2007–2009) or its aftermath (2010–2013). In some countries, like China, the number of granted patents per year has increased consistently, including in the period between 2007 and 2013.

[14] Correlation coefficients can have values from -1 to +1. A correlation coefficient of 0 indicates no linear relationship between the two variables. In social sciences, the value of a correlation coefficient above 0.40 usually indicates a strong relationship (Sweet and Grace-Martin 2008, p. 106–107).

[15] Tebaldi and Elmslie look at the association between several institutional indices, including the WGIs and two sets of patent statistics: the *U.S. Patent and Trademark Office (USPTO) and the World Bank.*

Table 1. Association between institutional indices and granted patents, 2010–2013

Institutional measures 2010–13	Pearson Correlation Number of granted patents, 2010–13	
	Total Average per million of population	Total Average per billion $ of GDP
Average WGI Percentile Rank, 182 countries	0.50**	0.48**
Average Total DTF Score, 178 countries	0.43**	0.43**

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

Source: WIPO Statistics Database for patent data at: http://www.wipo.int/ipstats/en/; the World Bank for the WGIs at: http://info.worldbank.org/governance/wgi/index.aspx#doc; and the DTF scores of the Bank Doing Business Index at: http://www.doingbusiness.org/data/distance-to-frontier (accessed April 2015).

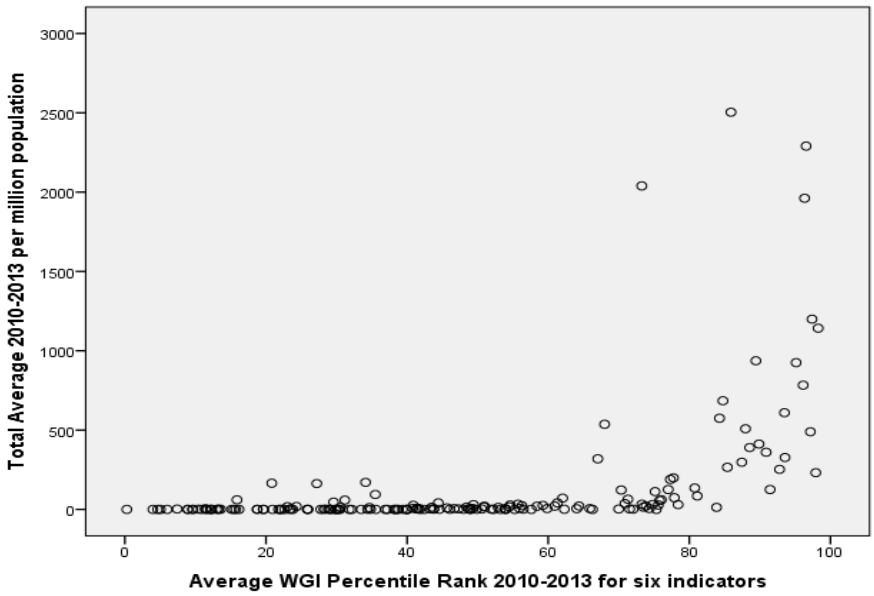
Table 2. Simple correlation of institutional measures and patent count

Institutional measure	Patent count, 1970 to 2003 USPTO	Patent count, 1995 to 2001 World Bank
Rule of Law, 133 countries	0.68	0.58
Risk of Expropriation, 85 countries	0.80	0.76
Average Institutional Index	0.72 (133 countries)	0.55 (85 countries)

Source: Tebaldi and Elmslie (2013, p. 892).

The scatter plot in Graph 1 below shows an interesting pattern: there is a steep increase in the number of patents per million of population at the point where the WGI rank is about 70 percent. We can assume that invention "blooms" after a country steps over this threshold of institutional quality. Scatter plots for the WGI rank and the number of patents per billion US dollars of GDP, as well as for the DTF score, demonstrate the same dynamic of the "inventive activity threshold." As noted above, both the WGI rank and the DTF score are broad indicators of institutional quality, reflecting a general institutional climate. The acknowledgment of the existence of this threshold indicating a certain level of institutional development after which invention spikes is noteworthy and has implications for the analysis of transitioning economies.

Graph 1. Granted patents per million of population in 182 countries and averaged WGI percentile ranks, 2010–2013



Source: WIPO Statistics Database for patent data at: http://www.wipo.int/ipstats/en/; and the World Bank for the WGIs at: http://info.worldbank.org/governance/wgi/index.aspx#doc (accessed April 2015).

3.2. Patenting in Mid-Range Emerging Economies

Entrepreneurship scholars stress that developing economies offer a different institutional environment to firms than that of developed, mature economies. This contextual difference affects the internationalization or innovation strategies of companies, including patenting activities, and these effects might be especially evident in emerging economies. Institutions can positively influence innovation through government subsidies to innovative companies and state investments in science or education, or negatively affect innovation through a lack of institutional support and infrastructure. "An innovator's intellectual property rights (IPR) for collecting income generated from an innovation must be protected by appropriate institutional systems, such as patent laws and copyright laws. Underdeveloped or improper institutional infrastructures may discourage or even stifle innovation" (Lu et al 2008, p. 367).

Hoskisson et al (2013) take the argument of the importance of the institutional context in emerging economies to the next level and argue that emerging economies are not homogenous. Their level of development varies along institutional and economic infrastructure axes. The so-called "mid-range" economies, which are progressing from an emerging economy status to a developed economy, are growing in economic significance and promise interesting theoretical insights into the process of transition (Hoskisson et al 2013, p. 1305). Hoskisson et al made a list of 60 mid-range emerging economies that, according to their methodology, fit the profile and rated them based on the level of institutional and infrastructure development (2013, p. 1303). This project ran simple correlations between the number of patents granted (adjusted for population and GDP) in this group of countries between 2010 and 2013 and institutional quality indices. The results are reported below in Table 3.

Table 3. 59 Mid-range emerging economies and institutional indices

Institutional measures 2010–2013	Pearson Correlation Number of granted patents 2010–2013	
	Total Average per million of population	Total Average per billion $ of GDP
Average WGI Percentile Rank, 59 mid-range economies	Correlation is not significant	Correlation is not significant
Average Total DTF Score, 59 mid-range economies	0.33*	0.32*

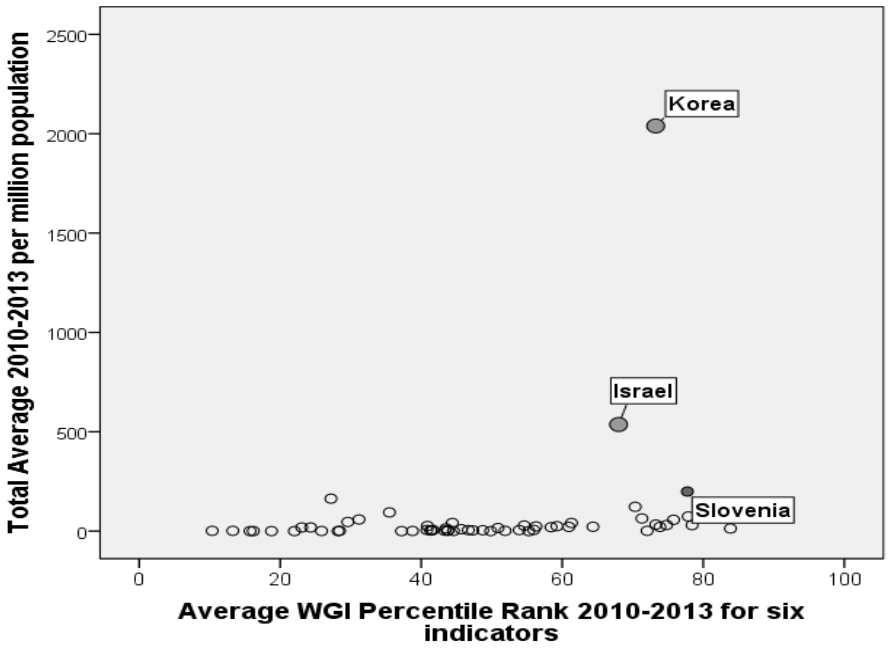
* Correlation is significant at the 0.05 level (2-tailed)

Source: WIPO Statistics Database for patent data at: http://www.wipo.int/ipstats/en/; the World Bank for the WGIs at: http://info.worldbank.org/governance/wgi/index.aspx#doc; and the DTF scores at: http://www.doingbusiness.org/data/distance-to-frontier (accessed April 2015).

Table 3 indicates a weak linear association between patent statistics and institutional indices in mid-range economies. There is, however, empirical evidence discussed, for example, in Lu et al (2008) that points to the association between inventive activity and institutions. In fact, an argument postulated by the "developmental state" literature is that economic and technological catch-up strategies in developing economies (in many cases executed by private firms) are assisted and supervised by state institutions. The answer to this puzzle may lie in the limitations of our data: four years are a comparatively short time span. Longitudinal studies might be more appropriate for looking at the relationship between different institutional arrangements and inventive activity expressed as patents. We also did not account for the possible time lag, i.e. the delay in the effects of institutional factors on inventive activity.

Another explanation lies in the choice of institutional indices. Both the WGI rank and the DTF score assess institutional quality based on composite indicators like political stability, rule of law, control of corruption, etc. These are broad-spectrum indicators pertaining to all companies and all industries. They reveal institutional conditions, an ecosystem where inventive activity can flourish or fade, but as in every intricate ecosystem, with its networks and spillovers, it is hard to identify cause-and-effect relationships. We can, however, get a glimpse of the threshold of inventive activity, i.e. a certain point (different for different institutional indices) after which the number of generated patents increases dramatically.

Graph 2. Granted patents per million of population in 59 mid-range economies and WGI ranks, 2010–2013



Source: WIPO Statistics Database for patent data at: http://www.wipo.int/ipstats/en/ and the World Bank for the WGIs at: http://info.worldbank.org/governance/wgi/index.aspx#doc (accessed April 2015).

Graph 2 is a scatter plot of the relationship between the number of granted patents per million of population in 59 mid-range economies over four years (2010–2013) and the WGI ranks for the same period. Most of these countries have a WGI rank between 40 and 60 percent. These countries have not reached the threshold of inventive activity, which becomes visible at about 70 percent, demonstrated by a steep increase in the number of patents thereafter. The results confirm the reasoning behind the classification of developing economies based on

their level of general institutional development and infrastructure/factor market development set out in Hoskisson et al (2013). The so-called "mid-range economies" are in an invention "limbo", floating in the range between about zero and 250 patents per million of population, with Israel and South Korea being obvious exceptions. The success of Israel and South Korea in building national systems of innovation, wherea combination of public and private efforts culminated in creating an innovation-friendly environment encouraging knowledge accumulation, technology development and diffusion, is well documented (Breznitz 2007; Sung and Carlsson 2003). Slovenia is also separating itself from the group of other emerging economies with respect to its invention rate and institutional progress.

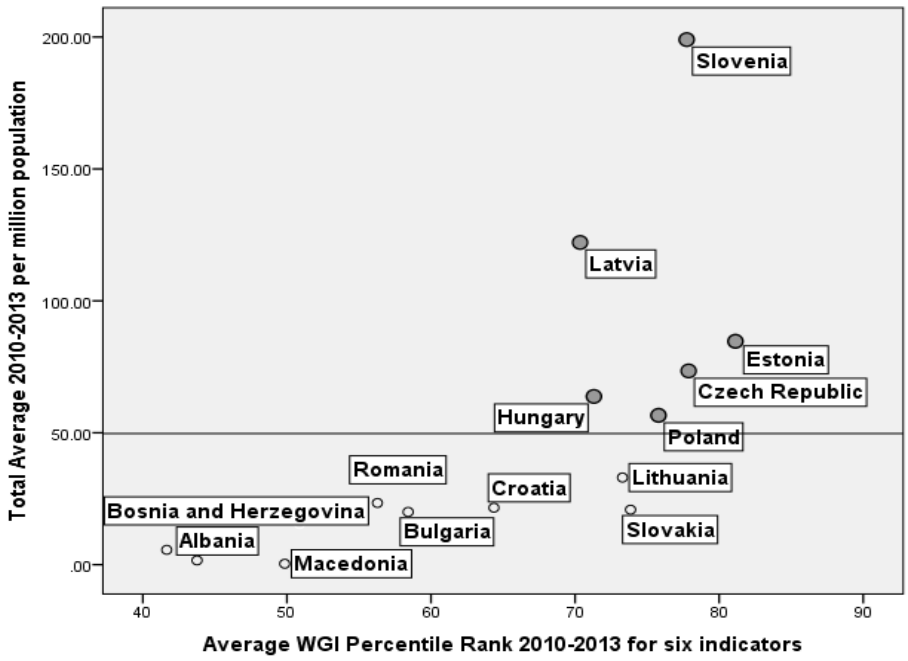
Our findings might be seen as alluding to a complex interplay between at least three factors. The first factor is a strategic effort on behalf of innovation exercised by a network of public and private institutions (a national innovation system). The other two factors include the general institutional context expressed by the WGIs and the fundamental business infrastructure measured by the DTF score. The two indices of institutional quality used in this report (WGI and DFT) are not directly related to innovation or invention, but they create a fertile soil for inventive activity. Our results confirm the theoretical conclusions drawn in North and Thomas (1973) on the importance of property rights' protection in the economic rise of the West. Rosenberg and Birdzell (1987) emphasized the role of political and economic freedoms in boosting technological and economic development. The countries that score highly on both indices of institutional quality used in this paper also file the highest number of patent applications per million of population and per billion US dollars of GDP.

3.3. Patenting in Central and Eastern Europe

The relationship between the number of granted patents per million of population and per billion US dollars of GDP for the years 2010–2013 in fourteen CEECs from the list of 59 mid-range emerging economies and the WGI ranks for the same period is plotted below in Graphs 3 and 4. Slovenia, Latvia, Estonia, the Czech Republic, Hungary, and Poland are invention leaders in this geographical category, with Slovenia having moved significantly ahead of its neighbors along both axes: institutional quality and the number of granted patents. In fact, according to the recent Innovation Union Scoreboard 2015, an innovation index which evaluates and ranks the innovation performance of the EU member states, Slovenia moved in 2015 into the category of "innovation followers," whose performances approach the EU average (European Commission 2015, p. 10). Slovenia is the only post-socialist country in this grouping.

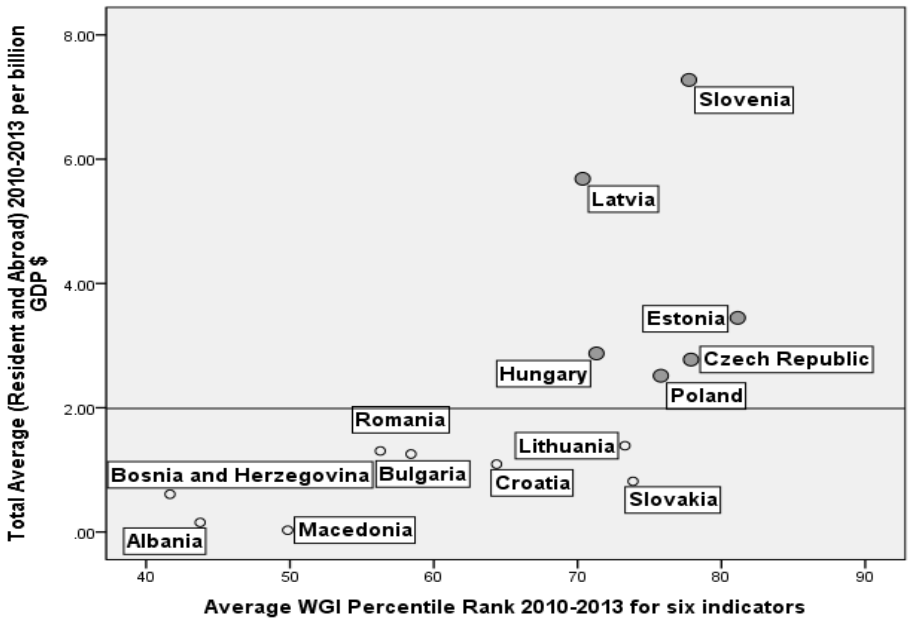
Based on our data, the six CEE innovation leaders, with a WGI rank at about 70 percent, are in the group of mid-range emerging countries closest to the threshold of inventive activity, and are, metaphorically speaking, about to step over it. The fact that these six countries entered the European Union in 2004 and went through a rigorous harmonization process of converging with the EU regulatory and institutional standards probably contributed to their leading position vis-à-vis their counterparts which either have not entered the EU yet or became members later.

Graph 3. Granted patents per million of population in fourteen CEECs and their WGI rank, 2010–2013



Source: WIPO Statistics Database for patent data at: http://www.wipo.int/ipstats/en/ and the World Bank for the WGIs at: http://info.worldbank.org/governance/wgi/index.aspx#doc (accessed April 2015).

Graph 4. Granted patents per billion US dollars of GDP in fourteen CEECs and their WGI rank, 2010–2013



Source: WIPO Statistics Database for patent data at: http://www.wipo.int/ipstats/en/ and the World Bank for the WGIs at: http://info.worldbank.org/governance/wgi/index.aspx#doc (accessed April 2015).

4. Conclusions

This paper is an exploratory study of the impact of institutions on inventive activity. Following the Griliches' advice to run correlations in order to determine if patent statistics can "measure anything interesting" (1990, p. 1670), this project did exactly that. The paper looks at the associations between *the average number of applications (adjusted for population and GDP) granted to residents from WIPO member-states between 2010 and 2013, and two sets of institutional factors: the* World Governance Indicators (WGIs) developed by Kaufmann et al (2010) and the Distance to Frontier (DTF) score of the World Bank Doing Business Index. The Pearson correlation coefficients for the relationships between the number of patents and the two institutional indices indicate a moderately strong, statistically significant relationship. The results also revealed an interesting pattern: there is a steep increase in the number of granted patents per million of population and per billion US dollars of GDP at

the point where the WGI rank reaches about 70 percent, and the DTF score – at 60 percent. This is the so-called "threshold of inventive activity." At some point (depending on the institutional index being used) the overall institutional climate stimulates an invention boom, i.e. a dramatic rise in the number of patents, the boiling point of inventive activity.

Institutions can encourage inventive activity or they can hinder it. It is widely acknowledged that in developing economies the inventive capacity of local firms can be handicapped by a lack of institutional support or deficient business infrastructure. Our results could not confirm that there is a positive (or negative) strong and statistically significant linear relationship between the national invention rates and institutional factors in 59 mid-range emerging economies (based on the list of countries in Hoskisson et al 2013, p. 1305). What we demonstrated is that the majority of mid-range economies are in an "innovation limbo" as they have not reached the threshold of inventive activity yet. This outcome supports the logic of ranking economies based on their institutional and infrastructure progress, since most of the countries in the so-called "mid-range" category do not rank highly on inventive activity. South Korea and Israel, the two innovation leaders, are notable exceptions and do not fit the profile of a "mid-range" level of development with respect to their inventive performance. These two countries are known for building efficient systems of innovation, which is reflected by their patenting activity.

Looking closer at the economies from Central and Eastern Europe, our data revealed heterogeneity in terms of developmental outcomes concerning both inventive activity and institutional quality. The country-leaders in both categories are those CEECs which entered the European Union in 2004 and ahead of their neighbors. These six leaders, namely Slovenia, Latvia, Estonia, the Czech Republic, Hungary, and Poland, have reached the 70-percent point on the WGI axis, but have not crossed the threshold of invention activity yet. They are close to it, however. In particular Slovenia, with about 200 patents per million of population, is closing the gap with developed counterparts and is moving into the category of world invention leaders.

The institutional indices used in this report (WGI and DTF) are broad-spectrum indicators of institutional quality. They reflect a general institutional environment and are a combination of many factors. The WGIs are the reflections of the development of democratic institutions, regulatory quality, rule of law, and other governance criteria. The World Bank Doing Business Index ranks economies on the ease of doing business, including basic legal infrastructure like the protection of property rights or contract enforcement. The accumulative effect of these institutions (not necessarily aimed at advancing innovation per se) may result in the intensification of inventive activity.

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Streszczenie

BADANIE PORÓWNAWCZE ROLI INSTYTUCJI W KSZTAŁTOWANIU NARODOWEJ DZIAŁALNOŚCI PATENTOWEJ W KRAJACH NA ŚREDNIM POZIOMIE ROZWOJU

Celem artykułu jest ukazanie znaczenia instytucji w kształtowaniu poziomu narodowej działalności wynalazczej. „Wynalazczość", jako część składowa procesu innowacji, mierzona liczbą przyznanych patentów, uważana jest za jedną z sił napędzających wzrost gospodarczy. W ujęciu ekonomii instytucji, czynnikiem stymulującym wzrost gospodarczy są sprawne instytucje. Stąd artykuł bada zależność między krajową zdolnością patentową, a jakością krajowych instytucji. W wyniku przeprowadzonej analizy, zaobserwowano wystąpienie efektu „progu działalności wynalazczej". Efekt ten obrazuje, że w momencie osiągnięcia przez kraj określonego poziomu rozwoju otoczenia instytucjonalnego, w rezultacie poprawy klimatu sprzyjającego powstawaniu innowacji, liczba zgłaszanych wniosków patentowych zaczyna szybko wzrastać. Artykuł wzbogaca międzynarodowy dorobek naukowy, potwierdzając znaczenie fundamentalnych instytucji, jak rządy prawa i wolność wypowiedzi, w stymulowaniu krajowej innowacyjności. Ukazano, że kraje na średnim poziomie rozwoju, w tym gospodarki Europy Środkowo-Wschodniej, w których jakość instytucji nadal nie osiągnęła poziomu krajów najwyżej rozwiniętych, nie przekroczyły jeszcze „progu działalności wynalazczej". Jednak w tych spośród państw regionu, które jako pierwsze przystąpiły do Unii Europejskiej, w wyniku harmonizacji otoczenia instytucjonalnego, nastąpiła intensyfikacja działalności patentowej.

***Słowa kluczowe**: innowacje, statystyki patentowe, działalność patentowa, działalność wynalazcza, instytucje, wskaźnik jakości instytucji*