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Impact of Business Environment on Innovation: Evidence from Eastern Europe and Central Asia

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Executive Summary

In this paper we make an attempt to determine whether non-financial business environment factors can be used to increase innovation undertaken by firms in Eastern Europe and Central Asia. We use firm-level pooled data from 2002 and 2005 rounds of the Business Environment and Enterprise Performance Survey to show that more competitive markets, improved tax administration, as well as better law enforcement and property rights protection, stimulate firms' innovative activities in these transition economies. We also investigate whether information environment influences the level of innovation companies undertake. We estimate an IV probit model where competition is instrumented due to a reverse causality problem. The results stand robust when our model is applied to different innovation variables, when alternative competition regressors are used, as well as when we control for access to finance. To explore heterogeneity between firms in our sample we conduct a subsamples analysis. We divide the companies with respect to age, size, ownership status, and regions. A number of interesting differences between firms is observed when it comes to the sensitivity of their innovative activities to studied factors.

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1 Introduction

Only puny secrets need protection. Big discoveries are protected by public incredulity.

Marshall McLuhan, teacher and philosopher (1911 - 1980)[1]

During the last 25 years, countries in Eastern Europe and Central Asia have gone through significant economic restructuring. The change in political regime in the end of 1980s and the beginning of 1990s imposed a need of deep reforms. Massive privatization was inevitable and every aspect of economic agents activities was subject to change. This led to chaos in most of these countries in the early years after the change, when many of them experienced hyperinflation and financial system crash. Some countries, however, managed to get faster through this period and start fresh earlier than others because they were very efficient in implementing reforms (Baltic and Central European countries). In this way they got closer to the Western European countries with respect to economic development and outperformed the ones which prolonged introduction of important changes in their economic systems. It is not a secret that reforms are a necessary step on the way to shortening the distance between transition countries and developed ones. In our research we focus on non-financial factors which can promote innovation in economies in transition.

Innovation is an important driver of productivity growth which is crucial for economic development. In previous research economists have proved that availability of financing has a significant impact on innovation (Gorodnichenko & Schnitzer 2013). However, attempts to improve access to finance for firms might be costly for financially-constrained governments, especially in transition economies. The main goal of this

[1] McLuhan, M. and Nevitt, B. (1972).

paper is to identify non-financial factors that drive innovation in those countries. We try to find cheaper ways to induce firms' innovative activities. The main area of our interest lies within business environment determinants which could lead to a higher degree of innovation firms undertake. The first factor we look at is competition firms are exposed to: we expect that a more competitive environment would induce companies to undertake more innovative activities. We also believe that problems in dealing with tax authorities can hinder business activities of firms and innovation activities in particular. Another determinant of business environment which we believe is particularly important for firms' innovative activities is the institutional framework in which they operate, so we try to incorporate it into our analysis as well. We choose to focus on legal conditions and quality of court system as it is critical for a firm to have confidence that its investment in innovation is protected. The last element of our research is informational environment a firm operates in, which has not yet been studied in details. What is important about all above-mentioned aspects is that their improvement could be achieved through reforms and does not require significant financial expense from governments. Thus, our research question is what kind of non-financial factors could be used by governments in the transition countries in order to stimulate firms' innovation and in this way induce macroeconomic growth.

The rest of the paper is organized in the following way. In Section 2 we describe the research that has already been done in the field of innovation: how it is linked to economic growth, factors affecting it, as well as ways to measure innovation. Section 3 presents data that we use for our analysis and its description; it gives the general picture of innovation and business environment in different countries. Section 4 describes the econometric approach we use in our research. In Section 5 we present our main findings and check whether they are robust. Section 6 outlines limitations that we faced while conducting the research. Section 7 concludes.

2 Literature Review

2.1 Innovation and Economic Growth

There is a considerable body of research conducted in order to understand which factors play important role in economic growth, that can be used to develop best government policies. They, in turn, would generate wealth and prosperity in countries. Both theoretical and empirical studies confirm the strong positive link between innovation and economic growth. Broadly speaking, all growth models are usually divided into two groups: models of exogenous and endogenous economic growth. The first ideas of endogenous growth appeared in the classic school in works of such economists as Adam Smith and Karl Marx (Verspagen 1992). Schumpeter can be viewed as one of the pioneers of innovation studies, in his *Theory of Economic Development* (Schumpeter 1911) he describes the role of an entrepreneur who acts as an innovator driving economic growth. Originated by the above-mentioned economists, these ideas developed into new, more profound theories.

Later on the assumption of endogenous growth was relaxed to exogenous by representatives of neoclassical school. Solow (1957) presented his exogenous growth model where technological growth played the main role. Using US data for the period of 1940-49 he concluded that only one-eighth of the production function shift for that period was attributable to increased labor intensity, while the rest seven-eighth was a result of productivity increase. Uzawa (1965), Arrow (1962b), Romer(1990, 1986), Lucas (1988), and others contributed to the body of neoclassical growth models by introducing endogenous growth models. Their models resemble the one of Solow (1957) in a sense that technological advance is the main driver of growth, but now technological change is caused by an endogenous innovation.Without going deeply into details, it is important to emphasize main novelties and contributions of these models. First, the role of

externalities is introduced. Knowledge can be divided into blueprints and technological knowledge, the latter sometimes is modeled as a combination of general and specific technological knowledge (Verspagen 1992). Blueprints as well as special knowledge can be appropriated by the inventor, but general technological knowledge is viewed as a public good, it generates spillovers. These kinds of externalities are positive since they increase the general knowledge pool in an economy. Some researchers also introduce the notion of negative externalities, so called "business stealing effect", when a new invention destroys the value of the previous one (Aghion & Howitt (1990), Grossman & Helpman (1991)). Presence of externalities leads to increasing returns to scale; it means that if one firm, say, doubles its output by some factor, other firms' output will also increase, thus, the average output increases more than proportionally. Another important issue, that neoclassical theories introduce, is protection of innovation. In exogenous growth models innovation is viewed more like a public good, and a logical question is: who will produce innovations if they are available exogenously? Possible solutions to this problem include patent systems, monopoly power of an inventor, as well as time-lead which can give an inventor a possibility to benefit from his invention before it gets used by other players (Kamien & Schwartz 1982). All these theories may differ in ways they model innovation, but they all conclude one thing: endogenous innovation is a central driver of economic growth.

Predictions produced by theoretical models have also been checked using empirical data and resulted in a number of influential papers. Mansfield (1984) concludes that for the period of 1960-76 R&D significantly contributed to the growth of productivity of US firms. An interest in verification of such positive and significant relationship between R&D expenditures and productivity growth has resulted in a substantial corpus of knowledge generated by numerous economists in the second part of the nineteenth century. Nadiri (1993) summarizes these findings in his paper where he reports direct

rates of return on R&D investment on both firm and industry level for number of countries. For firm-level data rates of return lie around 20-30%, for industry data they equal to 20-40%[2]. Raut (1995) uses panel data on private manufacturing firms from different sectors in India over the period 1976-1986 to test spillover hypotheses found in growth theories. He concludes that firms significantly benefit from the aggregate level of knowledge in all sectors but petrol-chemical industries. Another interesting evidence on knowledge spillovers can be found in the work of Jaffe (1986). He uses two cross-sections of American firms for 1973 and 1979 and finds that firms that conduct research in sectors for which the existing knowledge pool is bigger have higher return on a dollar spent for R&D.

Thus, both theoretical body of knowledge and empirical evidence suggest that innovation has a strong link to economic growth.

2.2 Innovation and Business Environment

According to EBRD Transition Report 2005 business environment is an important determinant of company behavior. Together with other factors such as restructuring activities (innovation) and competition, it is considered a major driver for improving firm performance. Business environment is captured by the following factors: business regulation; labor; taxation; institutions and property rights; infrastructure; finance; macroeconomic environment. The effect that most of them have on firm performance, separately as well as together, has been a focus of many studies.

The importance of all dimensions, internal and external, of the business environment for firm performance is outlined by Aguilar (1967), while the effect of the institutional part of it on organization performance is the emphasis in North (1990). He broadly

[2]Outliers are presented in both groups.

defines institutions as the "rules of the game" in which organizations act as agents of institutional change, and the way they interact affects the long-run performance of economies. North points out that the institutional framework is of great importance for economic performance and could be used to help companies get on productivity-increasing paths. This is also outlined by Eicher & García-Peñalosa (2006) who collect views of nine different authors on the role of institutions and property rights; they (institutions and property rights) are viewed as important determinants of country's economic development and growth as well as of innovative activities.

Dethier et al. (2008) review the recent literature and find business climate to be very important for enterprise performance. This is in line with the World Bank 2004 report which states that good business climate favors investments and productivity. Dethier et al. (2008) compare surveys made in 123 countries and including more than 100,000 firms. According to them, the critical aspects of business environment that many researchers find important are infrastructure, competition and regulation, financial constraints, crime, and corruption, which to some extend overlap with the factors EBRD finds important as well. The question is, what is their influence on economic agents behavior, their incentives to invest and innovate. Most studies examining this issues find these factors to be of high importance.

The infrastructure aspect of business environment is an essential determinant of firm productivity. Dollar et al. (2005) focus on losses due to power outages and difficulty to have a telephone line installed in China, Bangladesh, India and Pakistan. They conclude that these indicators of the business climate have significant negative impact on firms' total factor productivity (TFP). Escribano & Guasch (2005) study the effect of investment climate variables in Guatemala, Honduras and Nicaragua. According to them, infrastructure factors such as average duration of power outages, number of days to clear customs for imports, shipment losses as fraction of sales, and internet

access explain nine percent of company productivity. Another study by Escribano et al. (2009) examines the effect of infrastructure on TFP in manufacturing firms in 26 African countries. They divide the countries in two groups - those with high-income-growth and those with low-income-growth, and find that the infrastructure quality has a stronger impact on TFP for the companies operating in the second group.

The effect of the competition and regulation dimension of business environment on company performance is a subject of many studies as well. Bastos & Nasir (2004) focus on investment climate in five countries from Eastern Europe and Central Asia and conclude that competition, measured either as number of competitors or as pressure from domestic and foreign competitors on companies to develop new products, has the biggest influence on firms productivity, even higher than that of infrastructure. Labor regulations and tax administration are considered problematic for company performance. Gelb et al. (2007) argue that this is particularly applicable to companies operating in middle-income countries, where the state has more capabilities, compared to low-income countries, where the constraints to companies are primarily of elemental nature such as electrical power, access to finance, and ability to plan ahead. Diverse factors of business environment such as foreign and domestic private ownership, light regulatory burdens, limited corruption, technological infrastructure and labor market flexibility are proven to have positive impact on company growth and productivity by Beck et al. (2005), while Hallward-Driemeier et al. (2006) show that financial, legal, and corruption problems affect negatively firms growth, especially of small companies. Financial constraints are identified to have negative and significant impact on company growth (Beck et al. (2005) and Ayyagari et al. (2008)). Corruption is generally associated with lower firm growth (Fisman & Svensson (2007)), and keeping crime under control is one of the best ways to enhance firm growth according to Ayyagari et al. (2008).

However, there are not so many studies of the influence of business environment on enterprises' innovative activities. In his research of innovation in transition countries Krammer (2009) concludes that business climate is important for enterprises' innovative activities. Ease of doing business is a relevant factor determining company's innovative output for which patents are used as a proxy. In the researcher's regression, cost of doing business negatively and significantly affects innovation in the companies. This cost represents the effectiveness of country's regulations with respect to stimulating business environment, which plays an important role in determining companies' innovative activities in a country. Thus, a pro-business environment is essential for developing national innovation capabilities in transition countries. Other researchers focus on the effect that single aspects of business environment have on innovation. Gorodnichenko & Schnitzer (2013) study the effect that financial constraints have on domestic companies' innovative activities in the transition countries of Eastern Europe and Central Asia and find a significant negative relationship between the two. The impact of foreign competition on innovation has been studied in detail by Gorodnichenko et al. (2008) and they find that firms' innovation is positively influenced by this aspect of the business environment.

2.3 Innovation and Market Structure

Market structure has a significant impact on innovation process. Its influence has been first theoretically developed and then empirically proved by numerous economists in their books and research papers. In previous subsections we mentioned Schumpeter as one of the pioneers of innovation studies. Not only stressed he on the significant role of entrepreneur for economic development, but also underlined the link between market structure and innovation (Schumpeter 1942). First, he advocated the idea of tolerance to monopolization which is related to the problem of protection of intellectual property

and knowledge appropriation. Second, he thought that big firms are better prepared for undertaking R&D. This may happen because they can better cope with market failures related to innovative markets: uncertainty, indivisibility, and externalities (Arrow 1962a). In their book on industrial organization Belleflamme & Peitz (2010) provide a very good explanation of how the above-mentioned failures affect market structures and what motivates firms to innovate. The main postulates and results are presented in the following paragraph.

Externalities of undertaking R&D are unavoidable, they generate knowledge spillovers and can be difficult to manage. Therefore, lower number of competitors means lower chance for rivalry to copy an inventor's innovation result and to profit from it. Indivisibility failure places big firms in more favorable position relatively to small ones thanks to their ability to benefit from increasing returns in R&D. Finally, big firms are usually more diversified and, therefore, can better manage uncertainty. Thus, on the one hand, big firms with high market power should invest more in innovation. On the other hand, another concern is whether a monopolistic position in a market provides larger incentives to innovate. Belleflamme & Peitz (2010) take into consideration two incentives to innovate: from profitability and strategic point of view. Comparing profit incentives to innovate of a monopolist and a firm under perfect competition, they reach a conclusion that a competitive firm attributes higher value to innovation than a monopolist[3]. This is explained by the replacement effect: prior to innovation the monopolist's profit is positive, while the competitive firm just covers its costs. Therefore, a monopolistic firm "replaces" its existing profits with new, bigger ones, which means it has lower profit increase compared to a competitive firm. When the model is extended to an oligopoly setting, an increase in number of firms in a market leads to an increase in profit in-

[3]Their conclusion is based on a model for minor (non-drastic) process innovation that has an infinite-time patent protection.

centive to innovate, provided that the size of innovation is large enough. Finally, when it comes to strategic incentive to innovate, the theoretical evidence suggests that the monopolist threatened by entry has higher willingness to pay for innovation than the entrant[4]. This is known as efficiency effect: firms with high market power are willing to invest in innovation in their attempt to prolong their position in the market. There are also empirical studies which try to check whether theoretically predicted relationships between market structure and innovation hold in reality. Hamberg (1964) studies manufacturing firms in the US and finds positive relationship between R&D intensity and market concentration, however, a rather weak one. Phillips (1966) argues that innovation has an impact on market structure, and that weakening of patent rights for large corporations would reduce entry barriers and lead to more efficient allocation of resources. More recent studies of the US chemical industry by Arora (1997) also show that patents are used to deter entry and to influence market structure. Gorodnichenko et al. (2008) study innovation in transition economies and find that the pressure from foreign competitors has a strong effect on the probability of innovation.

2.4 Innovation and Information Flow

Information is an important input into many processes, and innovation activity is definitely not an exception. We have reasons to believe that involvement of firms into information flow and their access to knowledge are crucial not only for succeeding in innovation, but also in making attempts to innovate. Most researchers focus their attention on one of the two following aspects with this regard: knowledge spillovers and absorptive capacity. As it was mentioned above, knowledge spillovers, which we can see as information flow, play a prominent role in economic growth because knowledge

[4]Provided that the products are substitutes.

produced by one entity can be, partly or in full, utilized by others in an industry.This leads to a thought that amount of information available to a firm increases chances of innovation, hence that information can be viewed as a production factor. This idea is supported by Arrow (1962a) who states that information is a commodity and it needs a proper legal protection if one wants to achieve an efficient resources allocation. He writes:

> *"Information will frequently have an economic value, in the sense that anyone possessing the information can make greater profits than would otherwise be the case."*

According to him, information is both input and output in a process of innovation. According to other studies, the extend to which a firm can utilize information available to it depends on its absorptive capacity. Keller (1996) suggests that when it comes to technology and innovation it is difficult to decrease the gap between leaders and followers. This happens due to the fact that, even though a lot of information is available thanks to spillovers, it is important to be able to use and successfully implement available knowledge. He argues that it is human capital that is complementary to the existing body of knowledge in order to achieve progress. He also states that this factor, in contrast to information, should be usually generated internally.

It is usual to assume that the level of absorptive capacity depends on prior investments in knowledge accumulation. Nevertheless, Lenox & King (2004) show that managers of firms are able to increase their absorptive capacity by constructing appropriate information channels within a company. They also emphasize on number of information sources as an important factor of successful usage of information. In their paper Mate-Sanchez-Val & Harris (2014) find that absorptive capacity has an effect on innovation outcomes in Spain and the UK with a stronger effect for the latter one.

2.5 Measuring Innovation

Ever since researchers started studying innovation there has been a problem of measuring it. There are many ways to measure innovative activities of companies, and each of them has its strengths and weaknesses. Some researchers use R&D spending as innovation variable, some use patent count (Aghion et al. 2009).

R&D expenditures seem to be a good proxy for the devotion of a firm to innovation. However, the main shortcoming of using R&D expenditures is that not all R&D investments lead to innovation. The other problem is that total R&D expenditures is a rather messy number, it includes all different kinds of expenditures related to R&D like long-term versus short-term investments or investments into projects of different significance.

Number of patents registered by a firm is somewhat better measure of innovation, not ideal though, since it does not reflect the "quality" of an invention; one important finding can lead to a much stronger increase in firm's productivity than a dozen small ones. Schankerman (1991) proves the idea of different patent quality using data on patent application in France for the period of 1969-1987. He finds out that the number of patent applications in France for the period of 1977-1981 falls sharply, while the mean patent value increases abruptly[5]. Some researchers try to account for patent quality; Lanjouw & Schankerman (2004) use detailed patent information to construct index of patent "quality". Francis et al. (2012) use citation-weighted patent count to investigate the relationship between innovation and credit spread on bank loans, attempting to figure out whether innovation activity can be used as a signal to alleviate information asymmetries which arise in credit markets.

[5]This drastic change is related to the introduction of European Patent Convention which became effective in 1977. The idea of the convention was to reduce costs of multiple patent applications by applying one fee that is contingent on a number of countries specified by a patentee.

When it comes to measuring innovation in developing countries and countries with transition economies, it is not always possible to use the above-mentioned indicators. When analyzing innovation in such regions one needs to use a broader understanding of what innovation is. Oslo Manual (2005) provides guidelines for what to consider an innovation and how to report it. According to it, innovation is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". It also defines two ways the innovation can be achieved: the first one is when a firm "invests in creative activities to develop innovations in house", the second option is to acquire them from someone else. R&D and patents usually capture the first type of innovation developments, while the second one, as noted in the Manual, can be presented by the following activities: identifying new concepts for products, technology, marketing etc, buying technical information (including patents of other firms), developing human skills, investing in software, reorganization of management systems, developing new marketing and sales concepts.

3 Data

3.1 Data Source

For our master thesis we have decided to use the data gathered by the Business Environment and Enterprise Performance Survey (BEEPS). This is a firm-level survey performed in joint cooperation by the European Bank for Reconstruction and Development (EBRD) and the World Bank. It comprises of an extensive questionnaire aiming to assess the general business environment and obstacles for firms' growth and operations in the countries of Eastern Europe and Central Asia. The survey was conducted for the first time in 1999-2000 when 4,100 companies from 25 countries were included. In the next round in 2002 the number of respondent firms reached almost 6,700 from 27 countries and in the third round from 2005 approximately 10,700 firms from 29 countries were interviewed. The latest available round of the survey from 2008-2009 includes almost 12,000 enterprises in 29 countries.

For our research we decided to use pooled data for the companies which participated in the 2002 and 2005 rounds of the survey. The reasons to choose these particular rounds are that the questionnaires in these years are almost identical, and the structure of the sampling is preserved, both of which make the comparison between these rounds easier. Furthermore, the survey from 1999-2000 has a smaller scope and in 2008-2009 the questionnaire was significantly changed in order to make it compatible with other surveys performed by the World Bank, in this way leading to a drop of some variables which are of our interest. There is also a panel component of the BEEPS which was constructed after interviewing the same companies in consecutive rounds of the survey after 2002. However, this component is relatively small. It includes only 2,050 participants from both 2002 and 2005, and only 1,122 enterprises which participated in all 2002, 2005 and

2008-2009 rounds[6]. The pooled sample which we use for our research contains 16,322 firms of which 6,667 were interviewed in 2002 and 9,655 were interviewed in 2005. To construct our pooled data we included the 27 countries which were present in both 2002 and 2005 rounds of BEEPS[7] and excluded Spain and Ireland which where included only in the 2005 round.

The 2002 and 2005 rounds of BEEPS use random and representative samples in combination with quota sampling techniques. A specific number of firms was targeted to be included from each country and quotas for sector, size, ownership, location and exports were imposed. The service quota determines that companies from manufacturing and services sectors are to be included in the same proportion as they contribute to the GDP of each of the countries but not less than 15%. The firms included in the survey are classified by economic activity with ISIC Rev 3.1 codes 10-14, 15-37, 45, 50-52, 55, 60-64, 70-74, 92.1-92.4 and 93[8]. The survey does not include firms which operate in sectors subject to government price regulations and prudential supervision, such as banking, electric power, rail transport, and water and waste-water. Companies with only 1 employee or more than 10,000 employees were excluded as well as those established in less than 3 years before the survey was conducted. Moreover, both companies in big cities and in rural areas are included in the data which allows us to study

[6]The small number of companies included in the panel does not reflect a high exit rate in these countries. It is due to the fact that many firms did not want to participate in the next rounds of BEEPS (42%) as well as to the difficulty to reach eligible respondents in some firms (25%) (Gorodnichenko & Schnitzer 2013).

[7]These are 15 countries from Central and Eastern Europe (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Serbia and Montenegro, Slovak Republic, and Slovenia), 11 countries from the former Soviet Union (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Ukraine, and Uzbekistan) and Turkey.

[8]These activities are: Mining and quarrying; Manufacturing; Construction; Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods; Hotels and restaurants; Transport, storage and communications; Real estate, renting and business activities; Recreational, cultural and sporting activities; Other service activities, respectively.

diverse firms in all the countries.

3.2 Data Description

BEEPS contains questions about firm's innovative activities according to the Oslo Manual. These questions relate to whether a company has undertaken any of the following initiatives over the last 36 months: developed successfully a major new product line/service, upgraded an existing product line/service, or acquired new production technology. We implement these questions in our research by constructing dummy variables called *New Product*, *Upgraded Product*, and *New Technology*. Each of them equals 1 if the corresponding innovation was undertaken by a company and zero otherwise. To make sure these self-reported company measures are meaningful indicators of innovation, we plot the relationship between the probability of observing each innovation and the growth rate of real GDP per worker[9]. We include 2005 data for the 27 countries of our sample [10]. As it can be seen, the relationship is positive for all measures which means all three indicators of innovation are valid.

We also report the unconditional probability of innovation by country for both 2002 and 2005. As Table 1 shows, there are differences in the probabilities of observing the various types of innovation across countries and years. The probability of introducing a new product is relatively higher in Albania, Belarus, Bulgaria, Croatia, Lithuania, Moldova, Poland, Romania, and Ukraine with the general tendency of observing lower values in 2005 compared to 2002. In Albania, Bosnia and Herzegovina, Croatia, Romania, Tajikistan, and Yugoslavia the probability of introducing a new technology is

[9] See Appendix A.

[10] Probability of innovation is taken from BEEPS on country level; GDP per worker is taken from PEN World Table.

Table 1: Probability of innovation by countries.

	New Product		New Technology		Upgraded Product		Observations		
	2002	2005	2002	2005	2002	2005	2002	2005	Total
Albania	0.43	0.38	0.33	0.40	0.45	0.46	170	204	374
Armenia	0.31	0.41	0.26	0.52	0.42	0.58	171	351	522
Azerbaijan	0.31	0.52	0.22	0.51	0.31	0.33	170	350	520
Belarus	0.44	0.42	0.33	0.29	0.62	0.71	250	325	575
Bosnia and Herzegovina	0.39	0.43	0.33	0.45	0.61	0.62	182	200	382
Bulgaria	0.57	0.34	0.31	0.28	0.54	0.39	250	300	550
Croatia	0.51	0.44	0.37	0.44	0.74	0.83	187	236	423
Czech Republic	0.28	0.19	0.23	0.23	0.48	0.32	268	343	611
Estonia	0.29	0.28	0.32	0.19	0.51	0.61	170	219	389
FYR Macedonia	0.35	0.37	0.32	0.32	0.40	0.46	170	200	370
Georgia	0.33	0.31	0.29	0.28	0.44	0.43	174	200	374
Hungary	0.24	0.28	0.15	0.15	0.35	0.41	250	610	860
Kazakhstan	0.34	0.28	0.19	0.31	0.43	0.44	250	585	835
Kyrgyz Republic	0.41	0.37	0.30	0.43	0.54	0.60	173	202	375
Latvia	0.37	0.38	0.33	0.25	0.56	0.57	176	205	381
Lithuania	0.49	0.48	0.29	0.28	0.40	0.48	200	205	405
Moldova	0.51	0.45	0.30	0.39	0.59	0.58	174	350	524
Poland	0.43	0.35	0.27	0.34	0.56	0.49	500	975	1,475
Romania	0.47	0.32	0.31	0.42	0.70	0.58	255	600	855
Russia	0.39	0.35	0.30	0.30	0.50	0.51	506	601	1,107
Slovak Republic	0.33	0.33	0.34	0.23	0.77	0.70	170	220	390
Slovenia	0.28	0.16	0.33	0.29	0.41	0.29	188	223	411
Tajikistan	0.41	0.35	0.35	0.35	0.55	0.48	176	200	376
Turkey	0.18	0.29	0.15	0.31	0.27	0.37	514	557	1,071
Ukraine	0.45	0.48	0.37	0.31	0.57	0.65	463	594	1,057
Uzbekistan	0.28	0.16	0.22	0.21	0.44	0.17	260	300	560
Yugoslavia	0.38	0.38	0.35	0.37	0.59	0.68	250	300	550

relatively higher with no specific time trend. We observe bigger values on the probability of upgraded product for most countries in general with particularly high numbers reported in Belarus, Bosnia and Herzegovina, Croatia, Slovak Republic, and Yugoslavia. There is a tendency for increasing the probability with time.

BEEPS provides us with a variety of questions capturing the competition which firms are facing. The main competition variable which we use is composed of the answers to a hypothetical question:

If the company was to raise the prices of its main product/service by 10%, as compared to their current level in the domestic market (after allowing for any inflation), which of the following would best describe the result assuming that the competitors maintain their current prices?

1. Customers would continue to buy from the company in the same quantity as now;
2. Customers would continue to buy from the company, but in slightly lower quantity;
3. Customers would continue to buy from the company, but at much lower quantities;
4. Many of the customers would buy from the competitors instead.

The answers to this question reveal to a high extend the degree of market power possessed by companies which is associated with the intensity of competition they are facing, as argued by Belleflamme & Peitz (2010). The possible answers to that question are scaled from 1 to 4 where 1 stands for high market power and hence low competition, while 4 stands for low market power and high competition. We construct a variable called *Impact of 10% Price Increase* based on this question which we use to find out whether higher levels of competition induce companies to innovate more. We expect its estimated coefficient to have a positive sign in our regressions.

Apart from competition, BEEPS collects data on many other business environment aspects in the 27 transition countries. We use two of them in our research together

with one additional external indicator. In the survey a company is asked to rank how problematic certain factors are for the operation and growth of its business on a scale from 1 (No obstacle) to 4 (Major obstacle). We construct a variable based on the answers to this question with respect to tax administration. We call this variable *Obstacle Tax Administration.* We would like to see how the degree of this obstacle affects innovative activities of the companies and we expect coefficient on it to have negative sign. The answers to this question are self-reported and can suffer from measurement error, because they reflect how the firms perceive this problem, not necessarily how it is in reality. To correct for the measurement error we aggregate the data from this question on a country-industry-year level (as done by Aterido et al. (2007), Fisman & Svensson (2007)). We believe that it makes sense to do that since two firms operating in the same country and industry are exposed to the same business environment.

BEEPS contains questions about sources of information a firm uses in its operations as well as about quality of information available to a firm. This enables us to create a variable which serves as a proxy for information flow a firm uses. We use the following questions from the survey to construct a variable called *Information Index.*

Q1. How important are the following as potential sources of information about new suppliers for your firm?

[Response options range from 1 (Not important) to 5 (Extremely important)]

- Family and friends;
- Former employees;
- Prior employment of managers;
- Existing customers or suppliers;
- Government agencies;
- Business associations/chambers of commerce;
- Trade fairs and other public sources of information.

Q2. To what degree do you agree that:

[Response options range from 1 (Strongly disagree) to 6 (Strongly agree)]

- The information on laws and regulation affecting the firm is easy to obtain;
- The interpretations of the laws and regulations affecting the firm are consistent and predictable.

In order to combine the answers from both questions measured on different scales we first normalize them and then we sum them together with equal weights to obtain the values for the *Information Index*[11]. Higher values of the index mean that the companies are more involved in the information flow in the business environment which we expect to have positive effect on their innovative activities.

We also use one external country-level measure of business environment. This is the *Rule of Law* index which is reported in Kaufmann et al. (2009). They construct this aggregated indicator which captures "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence". *Rule of Law* is available for 215 countries around the world. It is reported every second year: for 1996, 1998, 2000 and 2002, after which it is reported each year. It is constructed by pooling together indicators that many different data providers give about the court systems, law enforcement and other topics included in *Rule of Law*.[12] One such type of data providers is surveys of individuals and domestic firms from the World Economic Forum's Global Competitiveness Report, the Institute for Management Development's World Competitiveness Yearbook, the World Bank /

[11] We follow the guidelines recommended in the OECD Handbook on constructing composite indicators: methodology and user guide . We include detailed description of the creation of our composite indicators in Appendix B.

[12] All these different indicators are measured on different scales so they are first normalized in order to have the same mean of zero and standard deviation of one, after which they are summed together to give the index values.

EBRD's business environment surveys, the Gallup World Poll, Latinobarometro, Afrobarometro, and the AmericasBarometer. Second type is what they call "public sector data providers" which includes the European Bank for Reconstruction and Development, the African Development Bank, the Asian Development Bank, the World Bank, the United States Department of State, and the French Ministry of Finance, Industry and Employment. Another type is nongovernmental organizations such as Reporters Without Borders, Freedom House, and the Bertelsmann Foundation. The last type is presented by commercial business information providers, such as the Economist Intelligence Unit, Global Insight, and Political Risk Services. Due to the specific regional focus of some of these data providers, only some of them give information relevant to the countries in Eastern Europe and Central Asia. Thus, *Rule of Law* for the 27 transition countries we are interested in is composed of 10 sources of information on average. More than 2/3 of these sources are representative [13] and the rest are non-representative. However, the role of the representative sources in the composition of the index is even higher because the values they provide are given higher weights in the index, while the non-representative sources are given lower weights as pointed out by Kaufmann et al. (2009).

For our *Rule of Law* variable we take values of the index from 3 years before the actual year of BEEPS. So, for 2002 round of BEEPS we use 1999 values of *Rule of Law*, and for 2005 round we assign values from 2002 index. We do this because the questions on innovation variables are posed in the following way: "Has your company undertaken any of the following initiatives over the last 36 months?". Therefore, we believe that lagged values for the index have more impact for the innovative activities over the 3 years span rather than current ones. However, the index was not reported

[13] According to Kaufmann et al. (2009), a source can be called "representative" if the values it reports are close enough to the ones of providers that cover the whole world.

for 1999, so to get these values we averaged the ones for 1998 and 2000. *Rule of Law* ranges from -2.5 to 2.5 in general but it varies from -1.52 to 1.11 in the 27 countries we are examining. We expect its effect on company innovation to be positive.

BEEPS also collects a lot of information about company characteristics. In our regressions we include control variables indicating firm size, age, location, whether it exports its products, what percent of its employees have university education, as well as what percent of its capacity it uses. These are usual controls for heterogeneity across companies, they have also been used by other researchers when studying firm-level data (Bastos & Nasir (2004), Dabla-Norris & Inchauste (2008) and Gorodnichenko et al. (2008)).

The descriptive statistics for all variables are presented in Table 2. Among the innovation variables the probability of upgrading a product is highest (0.502). A reason for that might be that even small changes can be considered upgrades to some products. The chances of developing a new product or new technology are relatively similar, they equal 0.359 and 0.308, respectively.

The mean value for *Impact of 10% Price Increase* is 2.545, which means that an average firm in our sample would face a moderate decrease in demand for its products if it increased its prices by 10%. The table also shows that *Obstacle Tax Administration* ranges from 1 to 3.8 with average value of 2.5[14].

Information Index varies between -1.148 and 1.971. As already mentioned, *Rule of Law* varies between -1.522 and 1.111 with a mean value of -0.326 for the 27 countries in our sample.

Approximately 26% of the firms export to other countries, while 70% of them are small and 11% are big meaning that around 19% of the firms are medium sized.

[14]As explained above, *Obstacle Tax Administration* is aggregated at industry-country-year level, thus, we do not expect it to range from 1 to 4 exactly.

Table 2: Descriptive statistics

Variable	Mean	St. Dev.	Min	Max	Obs.
Innovation					
New Product	0.359	0.480	0	1	16,288
New Technology	0.308	0.462	0	1	16,147
Upgraded Product	0.502	0.500	0	1	16,285
Competition					
Impact of 10% Price Increase	2.545	1.125	1	4	16,022
High Market Power	0.528	0.499	0	1	16,022
High Competition Pressure	0.669	0.471	0	1	16,108
Business Environment					
Obstacle Tax Administration	2.505	0.437	1	3.8	16,322
Information Index	0.000	0.497	-1.148	1.971	13,944
Rule of Law	-0.326	0.748	-1.522	1.111	54
Controls					
Exporter	0.257	0.437	0	1	16,226
Small	0.693	0.461	0	1	16,322
Large	0.113	0.317	0	1	16,322
Log(Age)	2.346	0.781	1.099	5.308	16,314
University Percentage	29.635	30.213	0	100	16,020
Capacity Utilization	79.389	20.918	0	100	15,872
Big City	0.375	0.484	0	1	16,322
Access to Finance	22.926	11.622	0.4	47.3	54

The youngest companies included in the sample are 3 years old, the oldest ones are 202 years old and the mean firm age is 10 years. 38% of the companies are located in big cities or capitals, approximately 30% of the employees have university education and companies use about 79% of their capacity on average. We also report the correlations between all our variables in Appendix C. There is no high correlation between our

independent variables, so we do not expect any multicollinearity in our regression. The only correlation from the table which can be considered high (-0.90) is between two of our competition variables, where one of them is a derivative of the other, and we use them one at a time.

4 Econometric Specification

4.1 Baseline Specification

In the baseline specification we analyze the relationship between innovation and factors affecting it by using the pooled firm-level data from BEEPS in 2002 and 2005. The following equation is estimated using probit model:

$$\begin{aligned} I_{isct} = \Phi\{&\beta_1 Comp_{isct} + \beta_2 TaxAdmin_{sct} + \beta_3 InfoIndex_{isct} \\ &+ \beta_4 RuleLaw_{ct-3} + \beta_5 Exporter_{isct} + \beta_6 Small_{isct} + \beta_7 Large_{isct} + \beta_8 log(Age)_{isct} \\ &+ \beta_9 UniversityDegree_{isct} + \beta_{10} CU_{isct-3} + \beta_{11} BigCity_{isct} \\ &+ I_s + C_c + Y_t + Error\} \end{aligned} \tag{1}$$

where I is a dummy variable for innovation; Φ stands for cumulative distribution function of a standard normal variable; I_s, C_c, Y_t denote industry, country, and year fixed effects, respectively. In our analysis we use 3 different innovation variables: *NewProduct, UpgradedProduct,* and *NewTechnology.* Each of these variables equals to one if innovation has been reported by a firm and zero otherwise. The following factors are used to explain innovation:

Comp is a proxy for competitive environment, represented by the variable *Impact of 10% Price Increase.*

TaxAdmin describes how much of an obstacle tax administration is for a firm's operations. This factor is represented by the variable *Obstacle Tax Administration.*

InfoIndex is a factor of information flow a firm uses in its operations. This factor is

represented by the variable *Information Index*.

RuleLaw is a proxy for the quality of institutional environment as well as for effectiveness of legal and court systems. This factor is represented by the variable *Rule of Law*.

The following variables are included in the model as controls:

Exporter is a dummy variable indicating whether a firm exports its products abroad. It equals 1 if a firm does so and zero otherwise. It is expected to have a positive sign, since international clients are more likely to demand more differentiated products (related to new product, upgraded product) or put pressure on decreasing costs due to intense competition from international markets (related to new technology).

Small is a dummy variable that equals 1 if a firm has between 2 and 49 employees and zero otherwise.

Large is a dummy variable that equals to 1 if a firm has between 250 and 9999 employees and zero otherwise.

Age represents how old a firm is and is measured as the difference between the year of the survey and the year a firm was founded. The log of the variable is used.

UniversityDegree is percentage of a firm's workforce that has some university education or higher. Positive sign is expected, as more educated workers are likely to generate new ideas which lead to innovation.

CU stands for *Capacity Utilization* and represents the percentage of facilities/workforce that was utilized by a firm relative to the maximum level. The question asked is: "In your judgment, what was your firm's output 36 months ago in comparison

with the maximum output possible using its facilities/man power at that time?" The sign is questionable. On the one hand, the closer a firm is to full capacity, the more efficient it is, therefore, higher probability of innovation can be expected from such a firm. The other line of thought suggests that the closer a firm is to its maximum capacity level, the more likely it is that the firm will allocate resources to increasing capacity, not to innovation.

BigCity is a dummy equal to 1 if a firm is located either in capital or in a city with population of over 1 million citizens. Otherwise, its value equals zero. The sign on this variable is expected to be positive.

Estimation of the above-mentioned equation enables us to test the following hypotheses:

HYPOTHESIS 1. *The more competition a firm faces, the more it is likely to innovate.*

HYPOTHESIS 2. *Better institutional environment leads to an increase in the probability of innovation by a firm.*

HYPOTHESIS 3. *A firm is more likely to innovate if it is involved in more intense information flow.*

4.2 Instrumentation Strategy

Using a simple probit model to estimate equation (1) might produce inconsistent results because we suspect our competition variable to be endogenous. This problem could arise due to the reverse causality between innovation activities and the intensity of competition. As we pointed out in subsection 2.3, the replacement and efficiency effects act in opposite directions. Therefore, it is possible that not only the level of innovative activity is determined by the market structure, but also that innovation has impact on the degree of competitiveness in the market. In other words, a more competitive environment can motivate companies to innovate more in order to outperform other

enterprises in the industry, while at the same time it is possible that an undertaken innovation increases a firm's market power.

This reverse causality problem could be fixed by using an instrumental variable which is correlated with the competition environment and does not directly influence innovation. The regulations which determine the ease of entry into a market certainly influence the intensity of competition. High level of such entry barriers is associated with fewer competitors in this market because it is difficult to start a business there compared to not that heavily regulated markets where entry is easier. Meanwhile, such regulations do not directly effect the innovation decisions made by companies. Fortunately, we find two questions in BEEPS which capture the entry regulatory environment:

Q1. Thinking now of unofficial payments/gifts that a firm like yours would make in a given year, could you please tell me how often would they make payments/gifts for the following purposes [Response options range from 1 (Never) to 6 (Always)]:

- To get connected to and maintain public services (electricity and telephone);
- To obtain business licenses and permits;
- To deal with occupational health and safety inspections;
- To deal with fire and building inspections;
- To deal with environmental inspections;
- To influence the content of new legislation rules decrees etc.;

Q2. Can you tell me how problematic are these different factors for the operation and growth of your business [Response options range from 1 (No Obstacle) to 4(Major Obstacle)]:

- Access to land;
- Title or leasing of land;
- Customs and trade regulations;
- Business licensing and permits;
- Labor regulations;

We use both these questions to construct our instrumental variable since they capture different types of entry barriers, and their combination makes our instrument stronger. In order to do that we first normalize the answers[15] because they are measured on a different scale. Then we sum them up by assigning equal weights to them and arrive at our *Index of Entry Barriers* variable which is specific for each company. Higher values of the index correspond to higher entry barriers.

We believe our *Index of Entry Barriers* will act as a good instrument for our competition variables because we construct it following Gorodnichenko et al. (2008) who study the effect of globalization on innovative activities using BEEPS and also need an instrument for their competition variables. In their paper they study the correlation between the index and the incidence of zero profits (taken from BEEPS data) and find a significant negative relationship between them. Moreover, they regress their entry barriers index on the turnover rate, survival rate, and entry rates which are provided at the 2-digit NACE industry level for five of the transition countries - Slovenia, Hungary, Estonia, Latvia, and Romania by Bartelsman et al. (2004). Their conclusion is that higher values of the entry barriers correspond to industries being more protected. Thus, the index captures the entry barriers effect and can serve as an instrument for competition.

[15]See Appendix B for creation of composite indicators.

5 Empirical results

5.1 Main Findings

In this section we describe estimation results for equation (1) which test our hypotheses stated in Section 4. We start by regressing *New Product* on *Impact of 10% Price Increase* and then by adding one variable of interest at a time we arrive at the exact specification of equation (1). The results of a regular probit estimation are presented in Table 3. As we can see, the effect of *Impact of 10% Price Increase* has negative sign and is significant in all columns, which contradicts our predictions about competition effect on innovation. The next variable we add is *Obstacle Tax Administration* which does not have significant impact on innovation in our regular probit model. When we add *Information Index* and *Rule of Law*, they seem to positively affect the innovation variable and are significant, as expected. All control variables have expected signs and almost all of them have high level of significance.

As it was explained above, our regression is likely to suffer from endogeneity due to simultaneity between innovation and competition variables, therefore, we use instrumental variables approach to correct for this. The results from an IV probit estimation are presented in Table 4.

Impact of 10% Price Increase has a negative sign in regular probit estimation. However, it becomes positive and implies strong effect once we control for endogeneity of the regressor which can be seen from the first column of Table 4. This supports Hypothesis 1. Our instrument proves to be relevant as we expected, which is confirmed by the strong significance of the first-stage coefficient on it. *Obstacle Tax Administration* becomes significant in the IV estimation, which is also aligned with our predictions.

Table 3: Baseline regresion results

Probit	New product			
	(1)	(2)	(3)	(4)
Business Environment Variables				
Impact of 10% price increase	-0.049***	-0.049***	-0.047***	-0.046***
	(0.010)	(0.010)	(0.011)	(0.011)
Obstacle Tax Administration		-0.032	-0.047	-0.059
		(0.040)	(0.044)	(0.044)
Information Index			0.166***	0.164***
			(0.024)	(0.024)
Rule of Law				0.358***
				(0.130)
Controls				
Exporter	0.334***	0.334***	0.324***	0.323***
	(0.027)	(0.027)	(0.029)	(0.029)
Small	-0.196***	-0.196***	-0.202***	-0.201***
	(0.029)	(0.029)	(0.031)	(0.031)
Large	0.091**	0.091**	0.064	0.064
	(0.041)	(0.041)	(0.044)	(0.0440)
log(Age)	-0.085***	-0.085***	-0.091***	-0.090***
	(0.015)	(0.015)	(0.017)	(0.017)
University Percentage	0.003***	0.003***	0.003***	0.003***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Capacity Utilization	-0.005***	-0.005***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Big City	0.151***	0.151***	0.136***	0.136
	(0.024)	(0.024)	(0.026)	(0.026)
R^2	0.080	0.080	0.085	0.085
Observations	15,222	15,222	13,083	13,083

Notes: The table reports the estimates of equation (1) using probit model. Country, industry, and year fixed effects are included in the regressions but not reported. Robust standard errors are reported in parentheses. *** indicates significance at 0.01; ** indicates signifiweekestcance at 0.05; * indicates significance at 0.1.

Information Index and *Rule of Law* stay positive and significant which is in line with Hypotheses 2 and 3, respectively. As for controls, moving from regular probit to IV probit does not change their signs, but changes magnitude and increases significance of some of them. We believe that the specification with instrumental variables gives consistent estimates of coefficients, therefore, we use this specification from now on in our analysis.

Table 4 also provides us with directions in which the variables affect other types of innovation and relative magnitudes of them. We can see that *Impact of 10% Price Increase* has a positive and significant effect on *Upgraded Product* and *New Technology*. Coefficient on *Obstacle Tax Administration* is negative and significant for *Upgrading Product*; it is not significantly different from zero for *New Technology*. We believe this happens due to the fact that tax-related procedures a firm follows (mainly reporting to tax authorities) are linked to products a firm produces or sells; they (procedures) do not depend on technology a company uses. Therefore, decisions to change a product portfolio may lead to additional efforts on behalf of an innovating company in dealing with tax authorities, while new technology does not. The effect of *Information Index* stays positive and significant also for *Upgraded Product* and *New Technology*. *Rule of Law*, on the other hand, loses its effect on *New Technology*. This, however, is in line with the theory from Oslo Manual (2005) which says that weakness of property rights, which is what *Rule of Law* captures, is not one of the major factors hampering process innovation activities[16].

In order to interpret the actual magnitudes of the factors we need to compute margins; they are presented in Table 5.

[16]According to Oslo Manual recommendations, as well as from theory of industrial organization, we categorize innovation captured by *New Product* and *Upgraded Product* as product innovation, while *New Technology* represents process innovation.

Table 4: IV probit regression for all innovation variables

IV probit	New Product	Upgraded Product	New Technology
	(1)	(2)	(3)
Business Environment Variables			
Impact of 10% price increase	0.753***	0.814***	0.733***
	(0.062)	(0.039)	(0.067)
Obstacle Tax Administration	-0.105**	-0.149***	0.022
	(0.043)	(0.042)	(0.050)
Information Index	0.091***	0.062**	0.073**
	(0.030)	(0.026)	(0.028)
Rule of Law	0.427***	0.453***	0.178
	(0.130)	(0.127)	(0.138)
Controls			
Exporter	0.202***	0.153***	0.119***
	(0.041)	(0.036)	(0.033)
Small	-0.146***	-0.131***	-0.183***
	(0.033)	(0.031)	(0.036)
Large	0.201***	0.173***	0.254***
	(0.041)	(0.040)	(0.043)
log(Age)	-0.063***	-0.031**	-0.044**
	(0.018)	(0.016)	(0.017)
University Percentage	0.003***	0.002***	0.003***
	(0.0005)	(0.0004)	(0.0005)
Capacity Utilization	-0.002***	-0.001**	-0.002**
	(0.001)	(0.0006)	(0.001)
Big City	0.099***	0.036	0.033
	(0.028)	(0.025)	(0.026)
Observations	9,555	9,548	9,491

Continued

Table 4. Continued

Notes: The table reports the estimates of equation (1) for all innovation variables. IV probit model is used. Endogenous variable *Impact of 10% price increase* is instrumented using *Index of Entry Barriers* variable. The first stage coefficient on *Index of Entry Barriers* equals -0.103 and is significant at 1% level. Country, industry, and year fixed effects are included in the regressions but not reported. Robust standard errors are reported in parentheses. *** indicates significance at 0.01; ** indicates significance at 0.05; * indicates significance at 0.1.

We can see that changing *Impact of 10% Price Increase* by one unit leads to an increase in the probability of developing a new product of 21.9%. Marginal effects for other innovation variables lie in the same magnitude: increasing competition by one unit results in an increase in the probability of developing a new technology of 21.4%, and it raises the probability of upgrading a product by 23.1%. However, we believe that it is more meaningful to look at marginal effects of some variables not when they are fixed at their means, as it is done in Table 5, but fixing them at certain values. In the case of our competition variable, it makes sense to see how the predicted probability of innovation increases if we change the value of this variable from, say 1 to 2 (which is moving from "Our customers would continue to buy from us in the same quantities as now" to "Our customers would continue to buy from us, but at slightly lower quantities"). This slight decrease in market power would contribute with 18.5% increase in the probability of developing a new product[17]. The biggest impact for this variable is observed when moving from 2 to 3 and it equals 27%. It is logical, since this change corresponds to the most significant loss of market power[18]. In extreme case,

[17]This number is calculated as follows. First, we obtain a predicted probability of developing a new product fixing *Impact of 10% Price Increase* at 1 and all other variables at their means; this gives us predicted probability of 0.102. Then we do the same fixing *Impact of 10% Price Increase* at 2 which gives us 0.287 in predicted probability. The difference between the two numbers is the marginal effect of increasing *Impact of 10% Price Increase* from 1 to 2 which equals 0.287 - 0.102 = 0.185 or 18.5%. We use the same approach for calculation of other effects of such type.

[18]See the exact formulation of the question in Section 3.

Table 5: Marginal effects evaluated at means

IV probit	New Product	Upgraded Product	New Technology
Business Environment Variables			
Impact of 10% price increase	0.219***	0.231***	0.214***
	(0.012)	(0.006)	(0.014)
Obstacle Tax Administration	-0.030**	-0.042***	0.001
	(0.012)	(0.012)	(0.014)
Information Index	0.027***	0.018**	0.021**
	(0.009)	(0.008)	(0.008)
Rule of Law	0.124***	0.129***	0.052
	(0.038)	(0.037)	(0.040)
Controls			
Exporter	0.059***	0.044***	0.035***
	(0.013)	(0.011)	(0.010)
Small	-0.042***	-0.037***	-0.053***
	(0.010)	(0.009)	(0.011)
Large	0.058***	0.049***	0.074***
	(0.012)	(0.011)	(0.013)
log(Age)	-0.019***	-0.009**	-0.013**
	(0.006)	(0.005)	(0.005)
University Percentage	0.001***	0.001***	0.001***
	(0.0002)	(0.0001)	(0.0001)
Capacity Utilization	-0.001***	-0.0004**	-0.0005**
	(0.0002)	(0.0002)	(0.0002)
Big City	0.029***	0.010	0.0010
	(0.008)	(0.007)	(0.008)
Observations	9,555	9,548	9,491

Continued

Table 5. Continued

Notes: The table reports margins for coefficients for equation (1) for all innovation variables after running IV probit model. Endogenous variable *Impact of 10% price increase* is instrumented using *Index of Entry Barriers* variable. Margins are calculated at means. Country, industry, and year fixed effects as well as controls are included but not reported. Robust standard errors are reported in parentheses. *** indicates significance at 0.01; ** indicates significance at 0.05; * indicates significance at 0.1.

moving from a position with high market power to the one with no market power (from 1 to 4) would result in 70% increase in the probability of developing a new product. For *Upgraded Product* the partial effect evaluated at means equals 23.1%. The biggest impact is observed, again, when moving from 2 to 3 and equals 29,8%. The impact of the same change in market power for *New Technology* is 25.8%.

An increase in *Obstacle Tax Administration* by 0.1 leads to a decrease in probability of innovation of 0.3% for *New Product* and 0.4% for *Upgraded Product*. An increase of this factor by one standard deviation (which equals to 0.44) reduces the chance of developing or upgrading a product by 1.3% and 1.8%, respectively.

Another variable of interest is *Information Index* which is used to proxy the extent to which a firm is engaged in an information flow. This factor has a significant impact on all innovation variables and an increase by 0.01 has a marginal effect equal to 0.02% for *Upgraded Product* and *New Technology*, and 0.03% for *New Product*. When increased by one standard deviation it raises the likelihood of innovation by 1.3% for a new product development, by 1% for developing a new technology, and by 0.9% for upgrading a product.

The other variable that has a significant impact is *Rule of Law*. An increase in this index by 0.01 increases the propensity to innovate by 0.05 to 0.13 percent. However, this does not tell us much about economic significance of this estimate, this is why we use a standard deviation of *Rule of Law* to understand its economic impact. An increase of one standard deviation of this variable increases the probability of developing a new

product by 9%, and the chance of upgrading a product by 9.3%.

There are also some interesting findings with respect to the control variables. Being an exporter has a strong effect which varies from 3.5 to 5.9 percentage points increase in the probability of innovation. We believe that there are two channels through which this effect is realized. First, exporting products exposes a firm to more competition from abroad which leads then to more innovation (consistent with Hypothesis 1). Second, being involved in export creates another informational channel which can be even more significant than domestic ones: through its interactions with foreign partners a firm is likely to learn about new types of products, new technology etc. This explanation is in line with Hypothesis 3. Size of a firm also has an effect on innovation and our results support Schumpeter's ideas that bigger firms are more prone to innovate relative to small ones (Schumpeter 1942). Being a small firm decreases the probability of innovation by 3.7 to 5.3 percent, while being a big one increases it by 4.3 to 7.4 percent[19]. As noted before, the negative sign on capacity utilization may suggest that the closer a firm is to its full capacity, the more resources and efforts it allocates to capacity increase rather than to innovation. Our results suggest that 1% increase in capacity utilization is associated 0.001% or less decrease in the probability of innovation which is an economically small effect. The share of employees with university education has a significant positive effect on innovation. One percentage point increase in the share of educated employees increases the probability of all types of innovation by 0.1%. Location has effect only on a new product innovation: being located in a big city or in a capital increases chances of developing a new product by 2.9%. On developing a new technology as well as on upgrading a product location does not have an impact.

Our analysis in this section suggests that competitive environment is the most im-

[19]The medium sized firms serve as a base category.

portant business factor driving innovation. It has by far the largest impact compared to other factors. However, other aspects of business climate such as ease of dealing with tax authorities and development of court and legal systems play significant role in innovative activities undertaken by firms. Access to information and its quality has small, but significant influence on the probability of innovation.

5.2 Robustness Checks

This section presents the robustness checks we perform in order to verify that the main results we have from our empirical estimation hold for different specifications of the model.

The first robustness check we perform along the way with estimating the baseline specification of our model by using three different dependent variables for innovation in order to capture the effect our explanatory variables have on various innovation activities. As we already mentioned, Table 4 reports the estimates from the IV probit estimation of our baseline model using three different dependent variables. We observe that the significance levels and signs of the independent variables in all three regressions are mostly kept the same. Only for *New Technology*, we see that *Obstacle Tax Administration* and *Rule of Law* are not significant, the reason for which has been explained in the previous subsection.

Another robustness check we do is to test if our results hold for other competition variables as well. In order to do this, we construct two alternative dummy variables for competition. The first one equals 1 if a firm has high market power as represented by answers 1 or 2 in the *Impact of 10% Price Increase* question, and zero otherwise. We would like to see if the fact that a company has a lot of market power, reduces its incentives to innovate as it is argued in theory by Belleflamme & Peitz (2010). Using this so called *High Market Power* variable instead of *Impact of 10% Price Increase* does

not lead to different results than the ones we had before. As columns (1), (4), and (7) of Table 6 show, the coefficients on *Obstacle Tax Administration*, *Information Index* and *Rule of Law* have the same signs and similar magnitudes as in Table 4. *High Market Power* has a negative and significant sign and confirms the theoretical predictions [20].

The other alternative competition variable which we use is based on the question: "How would you rate the importance of pressure from domestic competitors on key decisions about your business with respect to developing new products or services and markets?" Response options include: 1 (Not at all important), 2 (Slightly important), 3 (Fairly important), and 4 (Very important). We construct a dummy variable called *High Competition Pressure* which equals one if the firms has answered 3 or 4 to the above-mentioned question. This competition variable is relevant only for developing and upgrading a product. Columns (2) and (5) of Table 6 report the results of including this alternative competition variable[21]. Again the effect of higher competitive pressure on innovation is positive and significant as it is in our main results. Coefficients on *Obstacle Tax Administration* and *Rule of Law* stay significant and keep their signs. However, *Information Index* loses its significance in this specification.

We perform one more robustness check as we realize our model could suffer from omitting a variable capturing difficulties of access to financing, which is recognized as an important determinant of innovative activities for firms operating in the transition countries (Gorodnichenko & Schnitzer 2013). BEEPS provides a few questions which allow us to observe these difficulties. However, reverse causality is likely to be present between innovation decisions and access to financing. This is due to the fact that firms need financial resources to introduce innovation while at the same time more innovative

[20] We use the same instrument *Index of Entry Barriers* to correct the endogeniety problem which we suspect *High Market Power* suffers from due to the same reasons as *Impact of 10% Price Increase*.
[21] It is also instrumented by *Index of Entry Barriers*

companies might have easier access to such funds. Thus, in order to include in our model a variable related to access to finance at firm-level from BEEPS, we have to instrument two variables at a time - competition and access to finance. Theoretically, it is possible provided we have suitable instruments for both of them. Still, instrumentation of the additional endogenous variable made estimation of our model very difficult from a computational point of view. Instead, we include an external indicator capturing access to financing at country level. We create a variable called *Access to Finance* which represents the percentage of firms using banks to finance investment in each of the 27 countries in our sample for 2002 and 2005[22]. We believe this indicator captures the aggregate level of development of financial systems in these countries and in this sense is exogenous. Nonetheless, it cannot show each company's individual access to financing, thus we do not include it in our main model but only use it in an alternative specification. As column (3), (6), and (8) of Table 6 show controlling for access to finance does not change neither the sighs and magnitudes, nor the significance of the variables from our main specification. Thus, we believe that not including a variable capturing the difficulties to access finance in our main model does not undermine our results.

The robustness checks show that use of other innovation variables, alternative competition variables, as well as financing variable does not change our main results. The only concern we have relates to *Information Index*, which loses its significance when used with *High Competition Pressure*. We believe that this happens because the questions this variable is based on cover only a part of the informational environment firms deal with. Other than that, we can confirm that our model is well-specified.

[22]Source: the World Bank

Table 6: Robustness checks

IV Probit	New Product			Upgraded Product			New Technology	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High Market Power	-1.625***			-1.783***			-1.578***	
	(0.145)			(0.092)			(0.157)	
High Competition Pressure		1.475***			1.723***			
		(0.170)			(0.120)			
Impact of 10% Price Increase			0.751***			0.812***		0.727***
			(0.062)			(0.039)		(0.069)
Obstacle Tax Administration	-0.082*	-0.085*	-0.106**	-0.130***	-0.160***	-0.151***	0.030	0.0005
	(0.043)	(0.049)	(0.043)	(0.042)	(0.045)	(0.042)	(0.049)	(0.050)
Information Index	0.091***	0.003	0.091***	0.060**	-0.052	0.061**	0.070**	0.072***
	(0.029)	(0.038)	(0.030)	(0.026)	(0.032)	(0.026)	(0.028)	(0.028)
Rule of Law	0.442***	0.306**	0.419***	0.478***	0.321**	0.445***	0.178	0.161
	(0.131)	(0.144)	(0.131)	(0.127)	(0.138)	(0.127)	(0.139)	(0.139)
Access to Finance			0.004			0.006**		0.008***
			(0.002)			(0.002)		(0.002)
Controls								
Exporter	0.202***	0.313***	0.203***	0.151***	0.270***	0.155***	0.112***	0.120***
	(0.041)	(0.034)	(0.041)	(0.036)	(0.032)	(0.036)	(0.033)	(0.033)
Small	-0.142***	-0.153***	-0.147***	-0.127***	-0.132***	-0.131***	-0.180***	-0.185***
	(0.034)	(0.035)	(0.033)	(0.032)	(0.033)	(0.031)	(0.036)	(0.036)

Continued

Table 6. Continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Large	0.180***	0.202***	0.201***	0.148***	0.172***	0.173***	0.239***	0.256***
	(0.042)	(0.046)	(0.041)	(0.041)	(0.045)	(0.040)	(0.044)	(0.043)
log(Age)	-0.068***	-0.075***	-0.063***	-0.035**	-0.028*	-0.031*	-0.048***	-0.044**
	(0.018)	0.019	(0.018)	(0.016)	(0.017)	(0.016)	(0.017)	(0.017)
University Percentage	0.003***	0.004***	0.003***	0.002***	0.002***	0.002***	0.003***	0.003***
	(0.0005)	(0.001)	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0005)	(0.0005)
Capacity Utilization	-0.003***	-0.003***	-0.002***	-0.002***	-0.002***	-0.001**	-0.002***	-0.002**
	(0.001)	(0.001)	(0.0007)	(0.0006)	(0.0007)	(0.0006)	(0.0007)	(0.0007)
Big City	0.101***	0.094***	0.100***	0.033	-0.006	0.035	0.031	0.032
	(0.028)	(0.030)	(0.028)	(0.025)	(0.027)	(0.025)	(0.026)	(0.026)
Observations	9,555	9,613	9,555	9,548	9,606	9,548	9,491	9,491

Notes: The table reports the estimates of equation (1) for all innovation variables. IV probit model is used. Endogenous variables *Impact of 10% Price Increase, High Market Power* and *High Competition Pressure* are instrumented using *Index of Entry Barriers* variable. The first stage coefficient on *Index of Entry Barriers* equals 0.005 for *High Market Power*, -0.007 for *High Competition Pressure*, and -0.009 for *Impact of 10% Price Increase;* they all are significant at 1% level. Country, industry, and year fixed effects are included in the regressions but not reported. Robust standard errors are reported in parentheses. *** indicates significance at 0.01; ** indicates significance at 0.05;

* indicates significance at 0.1.

5.3 Subsamples Analysis

The results presented in the previous subsections relate to the whole sample of firms representing a wide range of countries and industries, having different characteristics with respect to size, age and other dimensions. In this subsection we look at possible heterogeneity in the effects of previously studied factors on innovation across different groups of firms. We find it interesting to group companies by ownership status, size, age, and regions. For each subsample we re-estimate equation (1) using instrumental variable approach and report only coefficients on business environment variables.

We start by looking at subsamples by age. For the majority of the countries in our sample the beginning of 1990s brought significant change in regime, hence, in conditions for business. That is why we take 1990 as a threshold and consider firms which were established prior to that as old, and the ones founded in 1990 and after as young. Table 7 contains the result of estimation for these two subsamples. The outcomes for young firms resemble to a high degree the results for our full sample, while old firms seem to follow different patterns of behavior. They are indifferent to changes in legal environment and information channels that our index captures. *Obstacle Tax Administration* preserves negative impact, but loses its significance. We believe that this can be observed due to the fact that old firms have deep-rooted traditions of doing business in unfriendly business environment, they have better connections to governments and thus can adjust to institutional imperfections better.

The size of a firm also leaves a trace on how sensitive its innovative activities are to different factors. In the previous subsection we have already established that bigger firms are more likely to innovate than smaller ones. Therefore, we expect to observe

Table 7: Subsample analysis by firms' age

IV probit	New Product	Upgraded Product	New Technology
Young			
Impact of 10% price increase	0.700***	0.784***	0.698***
	(0.084)	(0.051)	(0.083)
Obstacle Tax Administration	-0.085*	-0.159***	0.053
	(0.051)	(0.049)	(0.061)
Information Index	0.087***	0.058**	0.059**
	(0.029)	(0.026)	(0.027)
Rule of Law	0.481***	0.576***	0.197
	(0.151)	(0.144)	(0.168)
Observations	7,355	7,349	7,298
Old			
Impact of 10% price increase	0.898***	0.913***	0.814***
	(0.068)	(0.044)	(0.170)
Obstacle Tax Administration	-0.117	-0.108	-0.095
	(0.079)	(0.080)	(0.086)
Information Index	0.069	0.061	0.124
	(0.055)	(0.051)	(0.083)
Rule of Law	0.080	-0.023	-0.052
	(0.304)	(0.282)	(0.301)
Observations	2,200	2,199	2,192

Notes: The table reports the estimates of equation (1) for all innovation variables. IV probit model is used. Endogenous variable *Impact of 10% price increase* is instrumented using *Index of Entry Barriers* variable. **Young** group includes firms established in 1990 and after; **Old** group includes firms established before 1990. Country, industry, and year fixed effects as well as other controls are included in the regressions but not reported. Robust standard errors are reported in parentheses. *** indicates significance at 0.01; ** indicates significance at 0.05; * indicates significance at 0.1.

different result when estimating equation (1) for subsamples of big and small firms. We divide the firms into two groups - Small (less than 50 employees) and Medium & Big (50 and more employees). The results of the estimation can be found in Table 8.

Table 8: Subsample analysis by firms' size

IV probit	New Product	Upgraded Product	New Technology
Small			
Impact of 10% price increase	0.775***	0.829***	0.757***
	(0.065)	(0.039)	(0.071)
Obstacle Tax Administration	-0.097**	-0.109**	0.014
	(0.047)	(0.046)	(0.054)
Information Index	0.096***	0.073***	0.078***
	(0.031)	(0.028)	(0.029)
Rule of Law	0.586***	0.558***	0.402**
	(0.157)	(0.153)	(0.170)
Observations	6,574	6,570	6,522
Medium & Big			
Impact of 10% price increase	0.742***	0.794***	0.625***
	(0.131)	(0.094)	(0.188)
Obstacle Tax Administration	-0.146**	-0.189***	-0.065
	(0.060)	(0.057)	(0.074)
Information Index	0.054	0.034	0.089*
	(0.045)	(0.041)	(0.051)
Rule of Law	0.183	0.385	-0.176
	(0.261)	(0.282)	(0.239)
Observations	2,975	2,972	2,962

Notes: The table reports the estimates of equation (1) for all innovation variables. IV probit model is used. Endogenous variable *Impact of 10% price increase* is instrumented using *Index of Entry Barriers* variable. **Small** group includes firms with less than 50 employees; **Medium and Big** group includes firms with 50 and more but less than 10,000 employees. Country, industry, and year fixed effects as well as other controls are included in the regressions but not reported. Robust standard errors are reported in parentheses. *** indicates significance at 0.01; ** indicates significance at 0.05; * indicates significance at 0.1.

It is obvious that the original result found for the full sample is largely driven by small firms which constitute more than 2/3 of the total number of companies. For them all factors are important determinants of innovation (*Obstacle Tax Administration*

has no impact on *New Technology*, as already established by the results for the full sample). It is interesting to mention, though, that *Rule of Law* becomes significant even for *New Technology*, which stresses on the particular vulnerability of small companies to institutional failures. Medium and big companies, on the other hand, seem to be sensitive only to the market structure and tax administration issues. In subsection 2.3 it was mentioned that big firms are more successful in dealing with market imperfections. We believe that these companies have also better capabilities of overcoming problems related to institutional environment.

The next differentiation we use in our analysis is ownership structure. We have divided all firms into three groups - domestic, foreign, and state - based on the question:

"What percentage of your firm is owned by:

- private domestic individual(s)/company(s)/organization(s)
- private foreign individual(s)/company(s)/organization(s)
- government/state"

We consider a firm belonging to a certain ownership group if this type of owner has more than 50% possession in a firm. The estimates for these subsamples are presented in Table 9.

We can see that domestic firms follow the patterns of the full sample, for them all factors stay strongly significant. Even *Rule of Law* becomes significant for *New Technology*, just as for young firms. A drastic difference, however, can be observed in foreign firms subsample - they do not seem to respond to any of the institutional factors. What is also interesting is that for upgrading a product competition does not matter. In order to understand where this change comes from, we looked at the foreign sample in details. The biggest concentration of foreign firms is observed in manufacturing, and around 70% of them are exporters, which makes us believe that these companies outsource their production in countries with lower labor costs.

Table 9: Subsample analysis by ownership status

IV probit	New Product	Upgraded Product	New Technology
Domestic firms			
Impact of 10% price increase	0.808***	0.864***	0.785***
	(0.066)	(0.033)	(0.080)
Obstacle Tax Administration	-0.074*	-0.084*	0.032
	(0.047)	(0.047)	(0.055)
Information Index	0.080***	0.071***	0.080***
	(0.028)	(0.027)	(0.028)
Rule of Law	0.552***	0.556***	0.374**
	(0.154)	(0.150)	(0.168)
Observations	7,006	7,002	6,963
Foreign firms			
Impact of 10% price increase	0.681***	0.348	0.627**
	(0.226)	(0.433)	(0.258)
Obstacle Tax Administration	-0.085	-0.040	0.041
	(0.093)	(0.115)	(0.128)
Information Index	0.108	-0.010	0.080
	(0.087)	(0.076)	(0.084)
Rule of Law	0.348	0.529	0.368
	(0.421)	(0.465)	(0.442)
Observations	1,074	1,072	1,062
Government firms			
Impact of 10% price increase	0.784***	0.822***	0.294
	(0.144)	(0.102)	(0.368)
Obstacle Tax Administration	-0.074	-0.125	0.001
	(0.082)	(0.078)	(0.107)
Information Index	0.049	0.005	0.110
	(0.084)	(0.071)	(0.094)
Rule of Law	-0.644	-0.823**	-1.043**
	(0.416)	(0.390)	(0.478)

Continued

Table 9. Continued

Observations	1,080	1,079	1,075

Notes: The table reports the estimates of equation (1) for all innovation variables. IV probit model is used. Endogenous variable *Impact of 10% price increase* is instrumented using *Index of Entry Barriers* variable. Country, industry, and year fixed effects as well as other controls are included in the regressions but not reported. Robust standard errors are reported in parentheses. *** indicates significance at 0.01; ** indicates significance at 0.05; * indicates significance at 0.1.

Therefore, decision to differentiate their products by upgrading them might not come from the competition per se, but from the general consumer preferences they deal with in foreign countries. All this is in line with previous findings of Gorodnichenko & Schnitzer (2013) who conclude that firms with significant foreign ownership have other determinants of innovation compared to domestic ones. For state-owned enterprises the effect of competition stays positive and significant for developing or upgrading products, but it disappears for introducing a new technology. We think this might be for the following reason. New technology relates to process innovation, which implies that its introduction reduces costs. However, in many of the transition countries corruption schemes related to government purchases are flourishing, which highly distorts competition incentives. In other words, if a state-owned firm knows that it has already secured its sales to government (often at prices higher than market ones), then it has no incentives to invest in reducing costs, no matter what other competitors do: this firm stays out of direct competition with them. *Obstacle Tax Administration* and *Information Index* have no significant impact on firms' innovative activities. An interesting, not very surprising though, result is found for *Rule of Law* in the subsample of state-owned firms. The variable has a negative significant effect on the probability that these firms innovate[23]. We believe that this is caused by the deep-rooted traditions of doing business in the studied countries, where government institutions are the first suspects

[23]For *New Product* the coefficient is marginally significant.

Table 10: Subsample analysis by regions

IV probit	New Product	Upgraded Product	New Technology
CIS			
Impact of 10% price increase	0.769***	0.804***	0.729***
	(0.061)	(0.041)	(0.073)
Obstacle Tax Administration	-0.143**	-0.146**	0.032
	(0.062)	(0.061)	(0.073)
Information Index	0.041	0.023	0.050
	(0.036)	(0.035)	(0.038)
Rule of Law	0.477***	0.447***	0.176
	(0.157)	(0.152)	(0.165)
Observations	4,093	4,091	4,064
SEE			
Impact of 10% price increase	0.667***	0.621***	0.490*
	(0.190)	(0.226)	(0.294)
Obstacle Tax Administration	-0.048	-0.193*	0.018
	(0.117)	(0.108)	(0.141)
Information Index	0.142***	0.117***	0.071*
	(0.046)	(0.044)	(0.043)
Rule of Law	0.136	0.457	0.097
	(0.331)	(0.314)	(0.379)
Observations	2,662	2,660	2,647
CEB			
Impact of 10% price increase	0.755***	0.886***	0.836***
	(0.177)	(0.056)	(0.093)
Obstacle Tax Administration	-0.033	- 0.079	0.037
	(0.088)	(0.079)	(0.094)
Information Index	0.078	0.042	0.054
	(0.056)	(0.043)	(0.047)
Rule of Law	1.031*	0.644	-0.269
	(0.567)	(0.428)	(0.469)

Continued

Table 10. Continued

Observations	2,794	2,781	2,773

Notes: The table reports the estimates of equation (1) for all innovation variables. IV probit model is used. Endogenous variables *Impact of 10% price increase* is instrumented using *Index of Entry Barriers* variable. **CIS** stands for Commonwealth Independent States; **SEE** stands for Southeast Europe; **CEB** stands for Central Europe and Baltics. Country, industry, and year fixed effects as well as other controls are included in the regressions but not reported. Robust standard errors are reported in parentheses. *** indicates significance at 0.01; ** indicates significance at 0.05; * indicates significance at 0.1.

of corrupt activities. Hence, improving legal environment would limit possibilities for state-owned firms of abusing the system in their favor.

Finally, we look at regional subsamples. As mentioned previously, our full sample consists of 27 countries from Eastern Europe and Central Asia. However, they cover quite significant area to assume that conditions in these countries, as well as determinants of innovation, are the same. Therefore, we divide the countries into three regions: Commonwealth Independent States (CIS), Southeast Europe (SEE), and Central Europe and Baltics (CEB)[24]. Table 10 presents the results of the estimation for regional subsamples.

As in the previous sets of subsamples, competition variable stays significant for all specifications, which yet again confirms the strong link between market structure and innovation. As for the rest of the variables, differences are observed. *CIS* show the closest results to the full sample estimates with the only difference that *Information Index* has no real impact on innovation for them. For *SEE* and *CEB* subsamples *Obstacle Tax Administration* and *Rule of Law* lose their significance. We believe that this happens due to the fact that these countries generally have better institutions and

[24] **CIS** countries: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Ukraine, Uzbekistan; **CEB** countries: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, Slovenia; **SEE** countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR Macedonia, Romania, Turkey, Yugoslavia.

business conditions compared to CIS countries; many of the countries were part of the European Union or preparing to be a member of it. The mean of *Rule of Law* for *CEB* countries is 0.65, it equals -0,44 for *SEE* region and -0,97 for *CIS*.

To sum up the results from the subsamples analysis, there is heterogeneity across different groups of firms. The only factor which is important for all of them is market structure. This is not surprising, since it is very difficult for a rather small firm to create significant barriers to prevent entry of new firms. Thus, an increase in intensity of competition forces firms to improve their position relative to rivals, and innovating is a good way of achieving that. Institutional environment seems to be most important for young and small firms, as well as for companies with domestic owners. Big and old firms can better overcome institutional imperfections which makes them less sensitive to problems associated with tax administration and legal system. Regulatory framework appears to have more impact in the less developed countries of our sample. It is also important to say that for some subsamples number of observations is reduced more than eightfold, which exacerbates measurement error and could contribute to loss of significance in these small subsamples.

6 Limitations

One of the most common problems in working with survey data, such as BEEPS, is that the information it collects is self-reported by individuals or companies interviewed. This would say that answers to some of the questions could be affected to a large extend by personal feelings or perceptions of the respondents. Hence, the data contains some subjective information which often presents a skewed picture of reality. This causes problems in empirical research because one cannot observe the true values of some of the variables of interest. Instead, what can be observed is perceptions for these variables, which is referred to as measurement error. In our research we suspect that the answers companies give in BEEPS based on a certain scale are most vulnerable to this problem. We restrain our model to include only one variable based on such questions directly - *Obstacle Tax Administration*. We try to reduce the error it is measured with by using country-industry-year aggregated values for that question instead. This technique was helpful but we still cannot be completely sure that measurement error has been fully corrected for.

Another restrictive problem which we faced throughout our research was simultaneity. We managed to use instrumental variable approach to correct for this kind of issue with respect to our competition variables. However, we could not include in our regressions some variables of interest, which we suspected to suffer from reverse causality, due to the fact that possible instruments for them reduced our sample significantly and led to insignificant results. Furthermore, instrumenting more than one variable at a time made our model very difficult to estimate from a computational point of view.

Another issue is that there might be a time inconsistency between our explanatory variables and the dependent variables. This problem arises because the questions about innovation in BEEPS refer to the three year period prior to the date when the

survey was conducted, while most of the questions we use to construct our independent variables ask respondents to provide current level information, and only few have a retrospective component. Thus, the results of our estimation might be somewhat criticized. However, it should be noted that Gorodnichenko, Svejnar & Terrell (2008) prove in their paper that using current values for competition variables (which relate to pressure from foreign competitors in their case) is a reasonable strategy and it does not lead to biased estimates[25]. Apart from that, we try as much as possible to reduce this problem by using lagged values for variables when they are available.

A possible area of improvement for further research would be collecting more detailed data on information channels companies use, trying to account for both intensity and quality. Our *Information Index* suffers from limited scope of information sources it captures which makes it mostly applicable to small firms. It also might explain why it loses its significance for some of the subsamples.

The last point of our concern relates to possible omitted variable bias, since there are other firm-specific factors affecting innovation that we could not control for. The best way to solve this issue, in our view, would be to use panel data. Panel regression with fixed effects would eliminate the unobserved heterogeneity leading to more efficient estimates. Even though BEEPS provides two-dimensional data, the panel component for 2002 and 2005 is very small, and its size is reduced even further due to missing values.

[25]They also use BEEPS data to study the effect of competition on innovation.

7 Conclusion

The purpose of our master thesis was to answer what kind of non-financial factors could be used by governments in the transition countries in order to stimulate firms' innovation and in this way induce macroeconomic growth. Our contribution to the existing body of research on economic development in transition economies is that we combine few factors in one model to understand how they affect firms' innovative activities, unlike other papers which usually examine the effect of one or two factors on company performance indicators. Moreover, we include information flow as a separate factor affecting innovation in these countries. Our analysis showed that improvement in competitive environment, ease of dealing with tax authorities, access to good quality information sources, and effective legal enforcement lead to an increase in the level of innovative activities companies undertake.

We started by estimating the effect that market power, tax administration, legal environment and information flow have on a new product development for a pooled sample of 27 countries in Eastern Europe and Central Asia. We used instrumental variable approach to correct for endogeneity bias caused by simultaneity between innovation and competition variables. Competition proved to have the strongest relative impact on innovation; a decrease in the market power a firm has significantly increases the probability of innovation undertaken by it. The second biggest influence is observed for legal environment, an improvement of which also leads to an increase in probability of innovation. Problems firms face while dealing with tax administration are proven to hamper the probability of developing a new product. Intensity and quality of information companies use in their operations also have significant but economically small effect on innovation.

When we applied our model to two other types of innovation (upgrading a product

and introducing new technology), the results appeared to be close to the original innovation kind, with the only difference being that tax administration issues and legal and court systems have no significant impact on innovation related to new technology. Furthermore, our model proved to be robust to use of alternative competition variables as well as to inclusion of country level indicator for access to finance. Information factor showed divergence from its significance levels in some specifications which raised concern about the scope of the informational environment it captures.

To investigate possible heterogeneity between different types of firms included in our full sample, we estimated our model for subsamples of firms dividing them by age, size, ownership and region. We found that the full sample results are mostly driven by small, young, and domestic companies, which are very sensitive to quality of institutions as well as to competitive environment. Differences of various extend were observed in the other subsamples, however, competition proved to be important in almost all of them.

To conclude, if governments of countries with transition economies want to increase innovation levels on their path to economic growth, without using expensive financial incentives, the following areas should be targeted in their policies. First, improving competitive environment needs be set as top priority: anti-competitive practices should be eliminated, and entry barriers - eased. Second, property rights should be secured through developing legal system in order to incentivize firms to commit to long-term investment in innovation. Third, it is necessary to simplify processes related to tax collection and to decrease time spent dealing with tax authorities. These steps would help to achieve economic growth and prosperity for transition countries. An important task remains for future study; it lies in constructing better firm level information indices which would capture in greater detail sources of information a firm uses and their quality. These indices could be then used to better understand how firms use the information environment for innovation purposes.

References

Aghion, P., Blundell, R., Griffith, R., Howitt, P. & Prantl, S. (2009), 'The effects of entry on incumbent innovation and productivity', *The Review of Economics and Statistics* **91**(1), 20–32.

Aghion, P. & Howitt, P. (1990), 'A model of growth through creative destruction', *National Bureau of Economic Research* .

Aguilar, F. J. (1967), *Scanning the business environment*, Macmillan New York.

Arora, A. (1997), 'Patents, licensing, and market structure in the chemical industry', *Research policy* **26**(4), 391–403.

Arrow, K. (1962a), 'Economic welfare and the allocation of resources for invention', *The rate and direction of inventive activity: Economic and social factors* pp. 609–626.

Arrow, K. J. (1962b), 'The economic implications of learning by doing', *The review of economic studies* pp. 155–173.

Aterido, R., Hallward-Driemeier, M. et al. (2007), 'Investment climate and employment growth: The impact of access to finance, corruption and regulations across firms', *Inter-American Development Bank* .

Ayyagari, M., Demirgüç-Kunt, A. & Maksimovic, V. (2008), 'How important are financing constraints? The role of finance in the business environment', *The World Bank Economic Review* **22**(3), 483–516.

Bartelsman, E. J., Haltiwanger, J. & Scarpetta, S. (2004), 'Microeconomic evidence of creative destruction in industrial and developing countries', *Tinbergen Institute Discussion Paper* .

REFERENCES

Bastos, F. & Nasir, J. (2004), 'Productivity and the investment climate: What matters most?', *World Bank, Washington, DC* .

Beck, T., Demirgüç-Kunt, A. & Maksimovic, V. (2005), 'Financial and legal constraints to growth: Does firm size matter?', *The Journal of Finance* **60**(1), 137–177.

Belleflamme, P. & Peitz, M. (2010), *Industrial organization: Markets and strategies*, Cambridge University Press.

Dabla-Norris, E. & Inchauste, G. (2008), 'Informality and regulations: What drives the growth of firms?', *IMF Staff Papers* pp. 50–82.

Dethier, J.-J., Hirn, M. & Straub, S. (2008), 'Explaining enterprise performance in developing countries with business climate survey data', *World Bank Policy Research Working Paper Series* .

Dollar, D., Hallward-Driemeier, M. & Mengistae, T. (2005), 'Investment climate and firm performance in developing economies', *Economic Development and Cultural Change* **54**(1), 1–31.

Eicher, T. S. & García-Peñalosa, C. (2006), *Institutions, development, and economic growth*, Mit Press.

Escribano, A. & Guasch, J. L. (2005), 'Assessing the impact of the investment climate on productivity using firm-level data: Methodology and the cases of Guatemala, Honduras, and Nicaragua', *World Bank Policy Research Working Paper Series* .

Escribano, A., Guasch, J. L. & Pena, J. (2009), 'Assessing the impact of infrastructure quality on firm productivity in Africa: Cross-country comparisons based on investment climate surveys from 1999 to 2005', *World Bank Policy Research Working Paper Series* .

REFERENCES

European Bank for Reconstruction and Development (2005), *Transition Report 2005*, EBRD.

Fisman, R. & Svensson, J. (2007), 'Are corruption and taxation really harmful to growth? Firm level evidence', *Journal of Development Economics* **83**(1), 63–75.

Francis, B., Hasan, I., Huang, Y. & Sharma, Z. (2012), 'Do banks value innovation? Evidence from US firms', *Financial Management* **41**(1), 159–185.

Gelb, A., Ramachandran, V., Shah, M. K. & Turner, G. (2007), 'What matters to african firms? The relevance of perceptions data', *World Bank, Washington, DC* .

Gorodnichenko, Y. & Schnitzer, M. (2013), 'Financial constraints and innovation: Why poor countries don't catch up', *Journal of the European Economic Association* **11**(5), 1115–1152.

Gorodnichenko, Y., Svejnar, J. & Terrell, K. (2008), 'Globalization and innovation in emerging markets', *National Bureau of Economic Research* .

Grossman, G. M. & Helpman, E. (1991), 'Trade, knowledge spillovers, and growth', *European Economic Review* **35**(2), 517–526.

Hallward-Driemeier, M., Wallsten, S. & Xu, L. C. (2006), 'Ownership, investment climate and firm performance', *Economics of Transition* **14**(4), 629–647.

Hamberg, D. (1964), 'Size of firm, oligopoly, and research: The evidence', *Canadian Journal of Economics and Political Science* pp. 62–75.

Jaffe, A. B. (1986), 'Technological opportunity and spillovers of R&D: Evidence from firms' patents, profits and market value', *National Bureau of Economic Research Cambridge, Mass., USA* .

REFERENCES

Joint Research Centre-European Commission and others (2008), *Handbook on constructing composite indicators: Methodology and user guide*, OECD Publishing.

Kamien, M. I. & Schwartz, N. L. (1982), *Market structure and innovation*, Cambridge University Press.

Kaufmann, D., Kraay, A. & Mastruzzi, M. (2009), 'Governance matters VIII: Aggregate and individual indicators, 1996-2008', *World Bank Policy Research Paper* (4978).

Keller, W. (1996), 'Absorptive capacity: On the creation and acquisition of technology in development', *Journal of development economics* **49**(1), 199–227.

Krammer, S. (2009), 'Drivers of national innovation in transition: Evidence from a panel of Eastern European countries', *Research Policy* **38**(5), 845–860.

Lanjouw, J. O. & Schankerman, M. (2004), 'Patent quality and research productivity: Measuring innovation with multiple indicators', *The Economic Journal* **114**(495), 441–465.

Lenox, M. & King, A. (2004), 'Prospects for developing absorptive capacity through internal information provision', *Strategic Management Journal* **25**(4), 331–345.

Lucas, R. E. (1988), 'On the mechanisms of economic development', *Journal of Monetary Economics* **22**.

Mansfield, E. (1984), 'R&D and innovation: Some empirical findings', *University of Chicago Press* pp. 127–154.

Mate-Sanchez-Val, M. & Harris, R. (2014), 'Differential empirical innovation factors for Spain and the UK', *Research Policy* **43**(2), 451–463.

REFERENCES

McLuhan, M. and Nevitt, B. (1972), *Take today: The executive as dropout*, Harcourt Brace Jovanovich New York, NY, USA.

Nadiri, M. I. (1993), 'Innovations and technological spillovers', *National Bureau of Economic Research* .

North, D. C. (1990), *Institutions, institutional change and economic performance*, Cambridge university press.

Organisation for Economic Co-operation and Development (2005), *Oslo manual: Guidelines for collecting and interpreting innovation data*, OECD publishing.

Phillips, A. (1966), 'Patents, potential competition, and technical progress', *The American Economic Review* pp. 301–310.

Raut, L. K. (1995), 'R & D spillover and productivity growth: Evidence from indian private firms', *Journal of Development Economics* **48**(1), 1–23.

Romer, P. M. (1986), 'Increasing returns and long-run growth', *The journal of political economy* pp. 1002–1037.

Romer, P. M. (1990), 'Endogenous technological change', *Journal of Political Economy* pp. S71–S102.

Schankerman, M. (1991), 'How valuable is patent protection? Estimates by technology field using patent renewal data', *National Bureau of Economic Research* .

Schumpeter, J. A. (1911), *Theorie der Wirtschaftlichen Entwicklung, Munich and Leipzig: Dunker und Humblat; translated (1934) by R. Opie, The Theory of Economic Development*, Cambridge, MA: Harvard University Press.

Schumpeter, J. A. (1942), *Socialism, capitalism and democracy*, Harper and Brothers.

REFERENCES

Solow, R. M. (1957), 'Technical change and the aggregate production function', *The review of Economics and Statistics* pp. 312–320.

Uzawa, H. (1965), 'Optimum technical change in an aggregative model of economic growth', *International economic review* **6**(1), 18–31.

Verspagen, B. (1992), 'Endogenous innovation in neoclassical growth models: A survey', *Journal of Macroeconomics* **14**(4), 631–662.

World Bank (2004), 'World development report 2005: A better investment climate for everyone', *World Bank Group* .

Appendix A

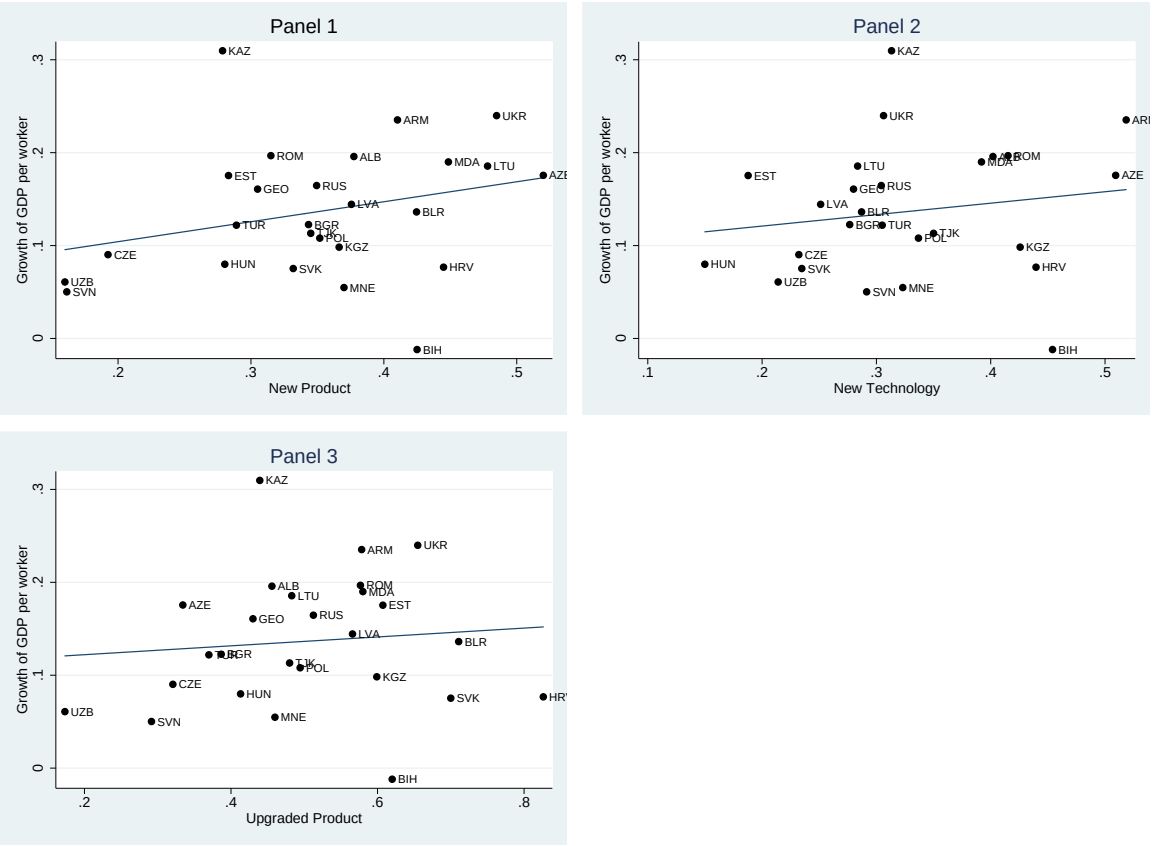

Figure 1. Economic Growth and Innovation

Appendix B

Creation of Composite Indicators

To create our composite indicators using questions which answers are based on different scales, we follow the guidelines of the OECD Handbook on Constructing Composite Indicators .

First, we normalize our variables. This procedure converts the values of the indicators to a common scale with a mean of zero and standard deviation of one.

For this purpose we consider which indicators I should be normalized and then calculate the mean $\bar{I}$ and standard deviation σ_I of each of them. Next, we input them into the following formula:

$$I_{norm} = \frac{I_i - \bar{I}}{\sigma_I}$$

This allows us to compute the standardized values for each of the indicators. Now the normalized indicators can be summed up into a composite index. To achieve this we sum them with equal weights according to the following formula:

$$CI = \sum_{j=1}^{n} w_j I_{norm,j}$$

where w_j stands for indicator's weight in the index.

Appendix C

Table 12: Correlation between variables

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
New Product	(1)	1.00															
Upgraded Product	(2)	0.44	1.00														
New Technology	(3)	0.37	0.34	1.00													
Impact of 10% Price Increase	(4)	-0.05	-0.06	-0.07	1.00												
High Market Power	(5)	0.05	0.06	0.08	-0.90	1.00											
High Competition Pressure	(6)	0.04	0.05	0.00	0.19	-0.17	1.00										
Obstacle Tax Administration	(7)	0.01	-0.03	0.05	0.04	-0.04	0.03	1.00									
Information Index	(8)	0.06	0.07	0.07	-0.02	0.02	0.10	0.01	1.00								
Rule of Law	(9)	-0.06	-0.04	-0.06	0.09	-0.08	0.15	-0.00	0.03	1.00							
Exporter	(10)	0.17	0.16	0.12	-0.02	0.01	-0.02	-0.05	0.06	0.12	1.00						
Small	(11)	-0.13	-0.14	-0.15	0.05	-0.04	0.03	0.01	-0.10	0.03	-0.29	1.00					
Large	(12)	0.09	0.09	0.11	-0.07	0.06	-0.06	-0.03	0.06	-0.03	0.23	-0.54	1.00				
Log(Age)	(13)	0.01	0.04	0.05	-0.02	0.02	-0.01	-0.04	0.06	0.12	0.16	-0.34	0.29	1.00			
University Percentage	(14)	0.08	0.03	0.03	-0.07	0.06	-0.08	-0.06	-0.02	-0.22	0.05	0.08	-0.04	-0.11	1.00		
Capacity Utilization	(15)	-0.10	-0.10	-0.08	0.01	-0.01	-0.01	-0.02	0.01	0.12	-0.07	0.05	0.00	-0.02	-0.03	1.00	
Big City	(16)	0.07	0.00	0.02	-0.06	0.05	-0.03	-0.03	0.01	-0.13	0.06	-0.05	0.06	-0.04	0.24	-0.06	1.00