What Determines Firms' Innovation in Eastern Europe and Central Asia

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Abstract

By employing a rich sample of firm-level data in seven Eastern Europe and Central Asian countries from Europe and Central Asia, our paper investigates core as well as some specific determinants of firm innovation. We find that the likelihood of engaging in innovation for a firm increases with its core socio-economic characteristics such as size, age, capacity utilization, domestic competition and foreign ownership. In addition to the estimates of these socio-economic covariates, the ultimate purpose of our study is to obtain more in-depth knowledge about the policy implacable factors for firm innovation that the countries could focus on. These policy-related factors are: (i) access to finance, (ii) human capital, and (iii) foreign trade. In this respect, our study finds that firm's innovation increases with better financial inclusion, greater human capital and engagement in foreign trade. We argue that these analysis and results, coupled with inclusive and targeted policies, can be used to enrich the process of private sector innovation in the region's countries.

Key words: Firm innovation, access to finance, human capital, foreign trade

JEL Classification: O31, G0, J24, P33

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1. Introduction

A large empirical and theoretical literature has shown that innovation plays a crucial role in economic growth and development (e.g. Baumol 2002, Aghion and Durlauf 2005). It is considered as a key channel through which enterprises can ensure their competiveness grows sustainably. Therefore, there is a large empirical literature suggesting that the extent of innovation is becoming significantly greater in private enterprises and they are deemed to play a leading role in the spread of the technological progress within as well as outside countries (e.g. Shleifer 1998, La Porta, Lopez-de-Silanes, and Shleifer 2002). In this regard, studying the determinants of firm innovation is an essential step in understanding how enterprises catch up to the technology frontier, and for designing adequate policies to foster growth and development.

Although there is large body of empirical literature on the determinants of firm innovation, most of these studies have been carried out in developed countries context. Nevertheless, due to a number of socio-economic, cultural and institutional factors, innovation process appears to be different in developed and developing countries. This paper indents to look at firm innovation determinants in a sample of developing countries.

Our study uses a representative survey over 3187 firms in seven Eastern Europe and Central Asian countries to empirically examine what are the determinants of innovation in private sector firms. The survey data is extracted from the Business Environment and Enterprise Performance Survey (BEEPs) of the World Bank which conducted in 2009. Using this micro level dataset, we first identify the core characteristics of firm innovation, and then focus on the role of financial development, human capital and foreign trade in affecting firms' ability to innovate. In particular, our research is aiming at addressing the following questions:

1. In general, are certain types of firms more innovative than others? If so, what are the core determinants of innovation?
2. How does access to finance associate with innovation among firms?
3. What is the role of human capital in firm-level innovation?
4. Do export-oriented enterprises innovate more?

Our study complements and extends the ongoing discussion on firm innovation in following three ways. First, and perhaps most importantly, this is the first study which specifically focuses on the determinants of firm innovation in a sample of Eastern Europe and Central Asian countries. In addition to core socio-economic determinants of innovation, our paper focuses on the causal evaluation of three additional determinants of innovation that can all be influenced by policy makers and development institution. Second, we define a firm innovation broadly, and include activities such as introduction of new products and technologies, research & development spending, and activities that adopt new production processes. Third, utilizing primary and representative dataset on

private sector firms in seven ECA countries, we conduct our study using econometric methods that can deal with problems inherent to the topic and the nature of our data.

The rest of our paper is organized as follows. Section 2 presents a conceptual framework of firm innovation and its association with access to finance, human capital and foreign trade. Section 3 is devoted to present the dataset we use, explaining the empirical specifications of our model. Section 4 shows our main results and analysis and in section 5 we conclude the paper and present some policy recommendations.

2. Conceptual Framework

2.1. Definition of a firm innovation

Despite the numerous studies on the topic of innovation, there is still a lack of consensus on a single definition of the concept. Nevertheless, in our study, we follow the definition suggested by the OECD's Oslo Manual (OECD, 2005) and define the firm-level innovation broadly. By taking the broad explanation of the term, "innovation is understood as a process that involves the generation, adoption and implementation of new products or practices within the organization". This includes both innovations that the firm in question is developing itself, as well as those adopted from other firms or organizations. In addition to the products and practices introduced or adopted by firms, spending on research and development (R&D) is also considered as a potential innovative activity. In fact, in developing countries resources allocated to R&D initiatives are thought to be one of the most frequent forms of innovation processes. In general, our definition of innovation can be split into three subcomponents:

1. Product innovation: the introduction of a good or service that is completely new.[2]
2. Product adoption: the introduction of a product that is substantially improved.
3. Research and Development: whether or not the firm has spent money on R&D is also part of the innovation processes.

The factors influencing firm innovation have different nature. In addition to core socio-economic characteristics of firms that exist in literature (i.e. age, size, ownership, legal status, competition etc.), there are a number of policy implacable factors that Multilateral Development Banks (MDBs) and policy makers strive to measure in order to design their policy interventions. Among many, there are three categories of factors that we think are relevant. These include access to finance, human capital and foreign trade. Below we briefly explain how each of these categories can associate with firm innovation and what kind of proxies we propose to use to measure them.[3]

[2] Here we do not distinguish between horizontal product innovation (producing a new product that does not displace existing product) and vertical product innovation (introduction of a product that makes an existing product obsolete).

[3] Although we could just use one measure for each of these categories, we tend to present at least one more alternative measure for robustness.

2.2. Access to Finance and Innovation

Innovation is considered one of the potential channels through which firm's access to finance affects its growth and development. Levine et al. (2000) show that financial sector development helps economic growth through more efficient resource allocation rather than through increases in capital accumulation and scale of investment at the firm level. Recent work done by Benfratello et al. (2006) found evidence of a positive effect of banking development on innovative activities among the firms operating in Italy. The literature also provides evidence that R&D is normally cash constrained which means the more capital available to firms the more spending will be done on R&D (i.e. Carreira and Silva, 2010; Cincera and Ravet, 2010; Bogliacino and Gómez, 2010; Hall and Lerner, 2009;). In general, it is assumed that financial constraints for private sector firms can prevent them from supporting any innovative activities.

In our study, we use two measures as proxies for access to finance by firms. The first measure, *Having a Credit*, shows whether a firm has a loan or line of credit. The following question from the BEEPS survey was used to construct the first measure, "At this time, does this establishment have a line of credit or a loan from a financial institution?". The variable is a dummy variable and answers consist of either 0 (no) or 1 (yes).

The second measure, *Having an Account*, reflects whether a firm has a bank account or not. To construct our second measure of firms' financial access, we use the following question from the survey: "Does this establishment have a checking and\or saving account?". The variable is a dummy variable and answers consist of either 0 (no) or 1 (yes).

2.3. Foreign Trade and Innovation

Export brings opportunities and incentives for domestic firms to innovate and improve their competitive position (Almeida and Fernandes, 2008). Particularly for private firms in developing markets, where a domestic competition is not well developed compared to advanced economies, many of these pressures and opportunities operate through increased competition from foreign firms. Sutton (2007) argues that in developing markets the exporting and importing activities of domestic firms raise their innovation presumably through capacity and technology transfer. In general, the literature tends to find that exporting firms appear to have higher efficiency.

In our study, using the BEEPS data base, we introduce two proxies for foreign trade, *Export Volume* and *Foreign Trade Pressure. Export Volume* shows the volume of firm's export in USD and has taken from the BEEPS question: "What is total value of exports of your establishment in last complete fiscal year?".

Foreign Trade Pressure presents firm's feeling on the degree of pressure from foreign competitors. The following question from the BEEPS was used to construct this measure: "What is effect of 'pressure from foreign competitors' on decisions to develop

new products?". The variable takes values 1 to 4 according to following categories: not at all important (1), slightly important (2), fairly important (3) and very important (4).

2.4. Human Capital and Innovation

Innovation economies rely on highly-skilled labor force. Human capital therefore plays an important role in supporting innovation and influencing overall firm behavior (Maksimovic et al. 2007). As the concept of learning is closely associated with innovation, a higher level of human capital facilitates adoption processes and knowledge spillovers within a firm. Furthermore, the experience and capabilities of top management also plays important role in firm's innovation processes (Maksimovic et al. 2007). In general, it is expected that firms with high skilled labor force and more experienced enterprises will have higher intensity and ability to make products innovation and to devote resources for R&D.

Using the BEEPS dataset, in our paper we measure the level of human capital by two proxies. First, *University Education*, shows the percentage of firm's employees with a university degree. This measure was constructed by using the following question from the BEEPS survey: "What is percentage of employees at end of fiscal year 'with a university degree'?".

The second proxy is *Management Experience*, which shows the total number of years of experience the top manager has had working in this sector, has taken from the BEEPS question: "How many years of working experience does the top manager have in this sector?".

3. Data and Empirical Model

3.1 .Data

The data source of this study comes from the Business Environment and Enterprise Performance Surveys IV (BEEPS IV) conducted by the World Bank in 2009 which contains the responses of 11,500 enterprises operating in the manufacturing and service sectors in 29 transitional countries. We chose all firms (3,187) that belong to seven countries from Europe and Central Asia[4]. Table A.1 in the appendix reports the list of the countries of our sample and the number of firms surveyed in each country respectively.

The structure of the BEEPS IV questionnaire consists of three modules. First, the basic questionnaire, the Core Module, which includes all common questions asked from all establishments in all sectors (manufacturing, services and IT). The second expanded variation, the Manufacturing Questionnaire, is built upon the Core Module and adds some specific questions relevant to the sector. The third expanded variation, the

[4] Albania, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey and Uzbekistan.

Services Module, is also built upon the Core Module and adds to the core specific questions relevant to either retail or IT.

In general, the BEEPS IV covers the topics such as firm characteristics (i.e. firm's age, size, owner, legal status), access to infrastructure (i.e. electricity, transportation, water), government relations (i.e. regulations, tax administration, corruption, construction permits), labor (i.e. number of temporary employees, permanent jobs), firm performance (i.e. capacity utilization, sales, export), access to finance (i.e. saving accounts, sources of investment financing), and business obstacles (i.e. ranking most important 15 obstacles to business).

The standard strata for every economy surveyed are sector of activity, firm size, and geographical location. The primary sampling unit of every survey is the establishment and firm size is stratified into: small (5-19 employees), medium (20 to 99), and large (100 and more) firms. The survey could be accepted at www.enterprisesurveys.org.

3.2. Empirical Model

The aim of our paper is to investigate the core as well as a number of specific determinants of firm innovation in a sample of seven Eastern Europe and Central Asia countries. To do this, we designed econometric regression models to capture innovation nature of firms. In all our regression models, dependent variable is either one of the three individual indicators of innovation based on firms' responses to survey questions, or an aggregated indicator that we established. Since three underlying indicators of firm innovation are dummy variables, those regressions are estimated using a binominal probit probability model. For the innovation index, we use ordered probit model.

As described below, our three outcome variables are binary and the fourth one is ordered. We perform our evaluation through two sets of models. In the first set, we include core socio-economic variables together with country as well as industry fixed effects. Second, we individually address the impact of access to finance, human capital and foreign trade on the firm innovation through three sets of regressions.

In general, we assume that firm's underlying response can be described by the following equation:

$$\boldsymbol{Y_{i,k}} = \boldsymbol{\alpha} + \boldsymbol{F(X'\beta)} + \boldsymbol{I(Z'\gamma)} + \boldsymbol{C(V'\delta)} + \boldsymbol{u} \qquad \textbf{(1)}$$

Where,

Y_i - underlying probability that firm $\boldsymbol{i}$ in country $\boldsymbol{k}$, has one of the innovative activities described above.

$\mathrm{F(X'\beta)}$ - is the vector of firm-level independent variables such as size, age, capacity utilization etc.

$I(Z'\gamma)$ - is the vector of industry dummies.

$C(V'\delta)$ - is the vector of country dummies.

u – is a disturbance parameter and it is assumed that the parameter has normal distribution.

In addition to core determinants of firm innovation, we build on the equation (1) to examine the effect of access to finance, human capital and foreign trade. Hence, our second regression equation is of the form:

$$\boldsymbol{Y_{i,k} = \alpha + F(X'\beta) + I(Z'\gamma) + C(V'\delta) + \Phi'\Omega + u} \qquad \textbf{(2)}$$

Where,

Y_i ; $\mathrm{F(X'\beta)}$; $I(Z'\gamma)$; $C(V'\delta)$ and u - are same as described in the equation (1)

$\Phi'\Omega$ - is a vector of variables characterizing different aspects of the firm's financing, human capital and foreign trade.

Using the BEEPS dataset, we develop four proxies that have been employed as the outcome variables measuring innovative activities of firms.

The first dependent variable, *New Product*, shows whether a firm has introduced new products or services in the last three years. The variable is dummy and answers vary between 0 (no) and 1 (yes).

Second, *Upgrade*, reflects whether a firm has upgraded its current product line or services. The variable is binary and answers vary between 0 (no) and 1 (yes).

Third, *Invest in R&D*, shows whether a firm invested in R&D (in-house or outsourced) in last three years. This variable is also dummy and takes value if answer is yes, 0 – otherwise.

The fourth variable, *Index 2*, is an aggregate measure of firm innovation that we formed by adding 1 for the following responses: if the firm introduced new product or upgraded an existing product. The index ranges from 0 to 2 with 2 indicating the firm is most innovative.

The followings are the brief explanation of the core independent variables employed in the regression equations (1).

Age

We use the year of establishment of firm and develop our *Age* variable.

Size

We use dummy variables *Small*, *Medium* and *Large* as proxy for size. In our data *Small* firms are defined as those with less than 20 employees, *Medium* firms employ 20 to 99 employees, and the *Large* firms employ 100 or more labor forces.

Capacity Utilization

We define capacity utilization as the amount of output produced relative to the maximum amount that could be produced with the firm's existing machinery, equipment and regular shifts.

Domestic competition

The level of domestic competition (both formal and informal) is used as a gauge to measure competition faced by firms. The survey question on "How much of an obstacle the formal and informal sector competitors to your operations?" is the proxy for this.

Ownership

We distinguish between firms that mainly (over 50 percent) owned by foreign versus the domestic owners, expecting that the former has higher likelihood of innovation compared to latter.

Country and industry fixed effects

Controlling for country and industry fixed effects is also important because certain countries or industries may be more prone to introducing new products, spending on R&D. Failing to capture this aspect may lead to biased results due to systematic covariates of regressors with the episode of more intensive reporting of innovative activity.

4. Results and Analysis

4.1. Descriptive Results

First we start our analysis by describing the development of innovation activities in the sample of 7 Eastern Europe and Central Asian countries over two periods of time that the BEEPS survey conducted. These periods are 2002 and 2009. As presented in Table 1, the percentage of types of innovation varies significantly in the BEEPS surveys conducted in two different times. On average, firms engaged in new production and upgrading an existing product lines increased from 35 and 45 percent in 2002 to 42 and 67 percent respectively. These differences are statistically significant at the 1-percent level. In contrast, spending on R&D went down from 24 percent in 2002 to 10 percent in 2009. One of the possible reasons of this decline can be explained by the detrimental effects of 2008-2009 global financial crisis observed in these countries.

Another conclusion that we can get from Table 1 is that in general, firms are more likely to upgrade their products than other type of innovative activities such as introducing new product or spending on R&D. For example, in 2009, 67 percent of sample firms upgraded their products compared to 42 percent of firms that introduced new products and only 10 percent of firms invested in R&D.

[Insert Table 1 here]

Table 2 summarizes the proportion of firms in our sample countries that undertook each of the three innovative activities in 2009. The countries in the ECA region show a great deal of variation across the three different categories of firm innovation. There is no single country where firms are uniformly more innovative across the all categories. Nevertheless, majority of firms from Central Asian region appear to be the most innovative in terms of introducing new products and upgrading existing ones, while firms from Eastern Europe are the most active in terms of investing on R&D. For example, 51 percent of Tajikistani firms reported that they introduced a new product and 78 percent upgraded an existing product line. However, only 11 percent of firms in Tajikistan invested in R&D compared to 30 percent of Albanian firms.

[Insert Table 2 here]

4.2. Econometric Analysis

4.2.1. Core determinants

The estimated coefficients of main equation (1) are presented in Table 3. Columns (1), (2) and (3) of the table report marginal effects of binominal probit estimates while Column (4) shows the coefficients of ordered probit model[5]. As expected, socio-economic characteristics of firms are important determinants of the extent of innovation a firm undertakes. In general, the findings of our study are very consistent with the results illustrated in the empirical literature (e.g. Pavitt 1984, Aghion et al. 2004 and 2005a, Cohen and Klepper 1996, Beckeikh, Landry, and Amara 2006).

Probability of undertaking different types of innovative activities increases with firm age. Older firms are more likely to develop new products, upgrade existing product line, and invest in R&D. According to our regressions, the probability of firm innovation increases between 0.1-0.2 percent with a unit change in age. This result is statistically significant at 1-percent level.

[Insert Table 3 here]

[5] In all models, we control for country and industry fixed effects. Although not reported in the table, our results indicate that not all countries and all industries are equally innovative. For instance, firms that innovate more belong to sectors such as electronics, machinery & equipment, fabricate metal products, chemicals, plastic & rubber and etc.

Firm size found to be economically as well statistically significant determinant of firm innovation. The marginal effects show that the likelihood of product innovation increases about 5 percent for medium and 7 percent for large firms compared to small firms. The probability of investing in R&D increases by 10 percent for large firms compared to smaller firms.

Controlling for firm size and age, we also find that firms with higher capacity utilization tend to be more innovative. One percentage point increase in capacity utilization leads to 0.1-0.2 percent increase in the probability of firm innovation.

Domestic competition is found to be positively associated with firm innovation. The coefficient on domestic competition is statistically significant, indicating that in our sample countries, firms facing with high domestic competition, both formal and informal, are more likely to innovate.

Much of the existing literature on innovation has treated the owners of firms as homogenous. However, Table 3 results show that foreign-owned firms tend to innovative more. One percentage point increase in foreign ownership of firm leads to over 0.1 percent increase in the probability of firm's innovation. However, the coefficient on R&D is non-significant which means that spending on R&D seems to be same for firms regardless of their ownership status.

In addition to core socio-economic characteristics of firms, there are a number of policy-specific factors that we aim at investigating in our study. Based on the above mentioned conceptual framework for association between those factors (access to finance, foreign trade and human capital) and firm innovation, below we try to empirically test our hypotheses. Our aim here is to verify the previously discussed theoretical predictions.

4.2.2. Access to Finance

First, we examine whether the access to firm financing affects the extent of innovation that a firm undertakes. Table 4 shows how access to finance, as proxied by two indicators: *Having a Credit* and *Having an Account*, affect firm innovation. Panel A of the table shows the effect of *Having a Credit* on innovation, while Panel B presents the impact of *Having an Account* on firm innovation.

The results of Table 4 present that access to finance has a positive and significant coefficient suggesting that firms with better access to external financing tend to be more innovative. Among two proxies, *Having a Credit* found to associate with significantly higher rates of firm innovation compared to *Having an Account*. Moreover, among three types of innovation, access to finance tends to play stronger role for the product innovation. For instance, obtaining a credit and having an account increase the probability of firm innovation by 12.5 percent and 5 percent respectively.

[Insert Table 4 here]

Although we do not specify the channels by which access to finance affects innovation, our econometric results confirm that in ECA countries financial inclusion of firms is significantly associated with their innovation performance.

4.2.3. Foreign Trade

Table 5 presents the results from probit estimations of the effect of foreign trade on the probability of engaging in one of the innovative activities. For the sake of robustness, we use two proxies for foreign trade, *Export Volume* and *Foreign Trade Pressure.* Panel A reports probit model results for *Export Volume* and Panel B shows the effect of *Foreign Trade Pressure* on firm innovation. In both panels, we include control variables explaining socio-economic characteristics of firms and also include country as well as industry dummies.

[Insert Table 5 here]

According to Table 5 results, international presence as a significant role in driving innovation among forms. For example, 1 percent rise in export volume of firm increases the probability of having innovative activity by 0.4-0.6 percent. Firms reporting that they face bigger pressure from foreign competitors have about 2 percent more likelihood of engaging in innovative processes.

It is interesting to note that pressure from foreign competitors seems to have larger influence on firm's decision to innovate compared to pressures from domestic competitors and customers. This result is presented in the following Table 6.

[Insert Table 6 here]

Panel A of Table 6 shows the summary statistics of the firms reporting that their decision on producing new product depends upon one of the following pressures: domestic competitors, foreign competitors and customers. As presented, majority of firms report that their innovation decision heavily depends on pressure from domestic competition and customers (60 and 51 percents respectively), while only 33 percent of firms see foreign competition as an important force to their product innovation. However, by investigating deeper, we find opposite result. In Panel B of Table 6, simple correlation coefficients between pressure measures and our three innovation indicators show that foreign competition plays more important role in actual innovative processes of firms compared to domestic competitors and customers. This means that the actual importance of foreign trade seems to be much higher than firms think about it.

4.2.4. Human Capital

Finally, we find a firm's human capital has an important influence on its innovation processes. We use equation (2) to estimate probit regressions of the probability of a firm engaging in innovation as a function of human capital. We present the results in Table 7. As mentioned above, we measure firm's human capital by two proxies: *University Education* and *Management Experience*.

[Insert Table 7here]

Both panels (Panel A and B) show that human capital has statistically as well as economically significant impact on firm innovation capacity. For example, 1 percentage point rise in firm's employees with university degree increases the likelihood of engaging in any innovation activity by 0.1-0.2 percent. Not only education level of employees, but also experience of top managers has significant influence on firm's innovation capacity. For example, 1 year increase in the prior experience of top manager will both increase the probability of introducing new product and upgrading existing product by 0.2 percent. However, we find that the number of years of prior experience the top manager has had in the same industry has no effect on whether the firm is investing in R&D or not.

5. Conclusion and Policy Recommendations

In light of importance of innovation on the political agenda of developing countries, it is necessary to provide guidance to decision makers on how firm innovation can effectively be boosted in practice. For this purpose, it is essential to empirically estimate the effects of a wide range of determinants suggested by the literature.

There are two sets of conclusions and recommendations that we can drive from our study. First, we find the effect of core socio-economic determinants on firm innovation in the sample of seven countries from the ECA region. Our empirical analyses indicate that older, larger, foreign owned firms and enterprises that close to their production frontier and face with large domestic competition are more prone to innovation.

Our second set of findings provides clear-cut evidence in the areas where policy makers and development institutions can be more influential in promoting innovation.

We find that the use of banking services such as credits and current accounts is associated with greater innovations by firms. This association is quite strong and statistically significant.

Providing support to private firms that need access to finance is clearly among the key challenges for innovation policy in the majority of ECA countries. Better access to finance can also promote new firm entry and promoting growth at the country level. Therefore, financial inclusion remains central to development particularly for under-served and fragile SMEs.

However, whenever financing constraints exist, other constraints are also present, suggesting that the interaction to these factors can worsen the financing problem. Therefore, lowering financial barriers, alongside with efforts to tackle productivity constraints, can be beneficial for private sector of countries.

International presence or foreign trade tends to influence firm's innovative activity positively. Although pressures both form domestic as well as foreign competitors found to be positively associated with firm innovation, we conclude that the latter appears to have higher influence on firm's innovation behavior compared to the former. In this regard, all policy efforts towards supporting foreign trade need to be enhanced with the aim of efficiently promoting innovation.

There is also a sound reason of having smaller effect of domestic competition than foreign trade in the developing countries. Aghion et al. (2005) argue that firms located in less business-friendly environments are less likely to respond to domestic competition (threat of entry) by innovating. This is because the pro-business environment enables these firms to be more efficient than firms in restrictive regulatory environments, and more efficient firms respond to competition by innovating. Therefore, one of the policy agenda of sample countries should be making the business environment more conducive in order to facilitate local firms efficiently leverage from the domestic competition growth.

We also find strong evidence that firm with high educated employees and more experienced top managers have significant influence on the extent of innovation it undertakes. This result supports the importance of human capital for firm innovation in all dimensions.

At the end, we want to mention two potential limitations of our current study. First, there is a need for further research to control for reverse causality that arises between our specific independent variables and innovation. Thus, firms that innovate may also be the ones that are able to raise bank financing, hire skilled employees or closely engaged in foreign trade. Second, inclusion of sectoral and country dummies may not be sufficient to remove all spurious correlation between covariates and innovation indicators. This is again something that future researches could focus on.

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Table 1. Firm innovation in 2002 vs 2009

Type of Innovation	Year	Percent	Diff. between years	*T-test*
	2002	35.5		
Introducing new product	2009	41.8	6.3***	*-3.423*
	2002	45.0		
Upgrade existing product	2009	66.9	21.8***	*-12.309*
	2002	24.0		
Investing in R&D	2009	10.4	-13.6***	*10.423*

Note: The symbols ***, **, * mean that the coefficient is statistically different from zero, respectively, at the 1-, 5-, and 10- percent levels.

Table 2. Firm innovation by country, 2009

Country	Introducing new product	Upgrading existing product	Investing in R&D
Albania	41.14	69.71	30.29
Azerbaijan	44.21	74.21	8.16
Kazakhstan	45.12	75.14	11.6
Kyrgyzstan	45.73	68.38	14.96
Tajikistan	50.99	78.31	11.55
Turkey	44.62	58.2	27.07
Uzbekistan	22.95	36.89	2.46

Table 3. Determinants of innovation: core model

	New product	**Upgrade**	**Invest in R&D**	**Index2**
Age	0.0016**	0.0013*	0.0008*	0.0040**
	[0.0007]	[0.0007]	[0.0005]	[0.0016]
Medium	0.0472**	0.0513**	0.0454***	0.1348***
	[0.0216]	[0.0206]	[0.0161]	[0.0487]
Large	0.0648**	0.0348482	0.1031***	0.1408**
	[0.0256]	[0.0231]	[0.0212]	[0.0574]
Capacity utilization	0.0004	0.0012***	-0.0001	0.0022***
	[0.0004]	[0.0004]	[0.0002]	[0.0008]
Domestic competition	0.0151***	0.0094**	0.0079***	0.0361***
	[0.0039]	[0.0038]	[0.0021]	[0.0089]
Foreign ownership	0.0015***	0.0015***	0.0001	0.0039***
	[0.0005]	[0.0005]	[0.0003]	[0.0011]
Pseudo R2	*0.0485*	*0.0787*	*0.1091*	*0.048*
Obs.	*3187*	*3187*	*3187*	*3187*

Note: The symbols ***, **, * mean that the coefficient is statistically different from zero, respectively, at the 1-, 5-, and 10- percent levels.

Table 4. The effect of access to finance on innovation

	Panel A. Having a Credit				**Panel B.** Having an Account			
	New product	**Upgrade**	**Invest in R&D**	**Index2**	**New product**	**Upgrade**	**Invest in R&D**	**Index2**
Credit	*0.1249****	*0.0566****	*0.0686****	*0.2555****	---	---	---	---
	[0.0197]	*[0.0190]*	*[0.0139]*	*[0.0450]*	---	---	---	---
Account	---	---	---	---	*0.0489**	*0.0484**	*0.0450***	*0.1362***
	---	---	---	---	*[0.0282]*	*[0.0287]*	*[0.0176]*	*[0.0651]*
Age	0.0016**	0.0013*	0.0009*	0.0041**	0.0015**	0.0013*	0.0008*	0.0040**
	[0.0007]	[0.0007]	[0.0005]	[0.0016]	[0.0007]	[0.0007]	[0.0005]	[0.0016]
Medium	0.0372*	0.0474**	0.0372**	0.1145**	0.0439**	0.0471**	0.0426***	0.1257***
	[0.0217]	[0.0207]	[0.0151]	[0.0489]	[0.0217]	[0.0207]	[0.0161]	[0.0489]
Large	0.0437*	0.0258	0.0865***	0.0984*	0.0603**	0.0304	0.0983***	0.1285**
	[0.0258]	[0.0242]	[0.0209]	[0.0571]	[0.0257]	[0.0245]	[0.0211]	[0.0577]
Capacity utilization	0.0004	0.0012***	-0.0001	0.0023***	0.0004	0.0012***	-0.0001	0.0020***
	[0.0004]	[0.0004]	[0.0002]	[0.0008]	[0.0004]	[0.0004]	[0.0002]	[0.0008]
Domestic competition	0.01487***	0.0088**	0.0072***	0.0339***	0.0161***	0.0095**	0.0080***	0.0361***
	[0.0039]	[0.0038]	[0.0027]	[0.0089]	[0.0039]	[0.0038]	[0.0027]	[0.0089]
Foreign ownership	0.0015***	0.0015***	0	0.0039***	0.0014***	0.0015***	0	0.0038***
	[0.0005]	[0.0005]	[0.0003]	[0.0011]	[0.0005]	[0.0005]	[0.0003]	[0.0010]
Pseudo R2	*0.0577*	*0.0808*	*0.118*	*0.0526*	*0.0491*	*0.0794*	*0.111*	*0.0486*
Obs.	*3187*	*3187*	*3187*	*3187*	*3187*	*3187*	*3187*	*3187*

Note: The symbols ***, **, * mean that the coefficient is statistically different from zero, respectively, at the 1-, 5-, and 10- percent levels.

Table 5. The effect of foreign trade on innovation

	Panel A. Export Volume				**Panel B.** Foreign Pressure			
	New product	**Upgrade**	**Invest in R&D**	**Index2**	**New product**	**Upgrade**	**Invest in R&D**	**Index2**
Export (log)	*0.0061****	*0.0053****	*0.0041****	*0.01625****	---	---	---	---
	[0.0018]	*[0.0017]*	*[0.0011]*	*[0.0040]*	---	---	---	---
Foreign Pressure	---	---	---	---	*0.0169**	*0.0193***	*0.0173****	*0.0501***
	---	---	---	---	*[0.0091]*	*[0.0081]*	*[0.0061]*	*[0.0209]*
Age	0.0014**	0.0012*	0.0007	0.0036**	0.0015**	0.0013*	0.0009*	0.0031**
	[0.0007]	[0.0007]	[0.0005]	[0.0016]	[0.0007]	[0.0007]	[0.0005]	[0.0017]
Medium	0.0403*	0.0452**	0.0382**	0.1163**	0.0359	0.0435**	0.0425***	0.1079**
	[0.0217]	[0.0207]	[0.0160]	[0.0489]	[0.0220]	[0.0211]	[0.0164]	[0.0498]
Large	0.0449*	0.0179**	0.0803***	0.0895	0.0559**	0.0242	0.0982***	0.1142*
	[0.0262]	[0.0248]	[0.0211]	[0.0589]	[0.0260]	[0.0246]	[0.0215]	[0.0586]
Capacity utilization	0.0002	0.0010***	-0.0002	0.0017**	0.0003	0.0011***	-0.0004	0.0018**
	[0.0004]	[0.0004]	[0.0002]	[0.0008]	[0.0004]	[0.0004]	[0.0002]	[0.0008]
Domestic competition	0.01632***	0.0097**	0.0083***	0.0369***	0.0157***	0.0093**	0.0065**	0.0355***
	[0.0039]	[0.0038]	[0.0027]	[0.0089]	[0.0040]	[0.0031]	[0.0028]	[0.0092]
Foreign ownership	0.0013***	0.0014***	0	0.0036***	0.00151***	0.0014***	0.0001	0.0031***
	[0.0005]	[0.0005]	[0.0003]	[0.0011]	[0.0005]	[0.0005]	[0.0003]	[0.0011]
Pseudo R2	0.0511	0.0809	0.1158	0.0503	0.051	0.082	0.114	0.0508
Obs.	3187	3187	3187	3187	3069	3069	3069	3069

Note: The symbols ***, **, * mean that the coefficient is statistically different from zero, respectively, at the 1-, 5-, and 10- percent levels.

Table 6. Foreign vs Domestic Competition

	Panel A. Summary Statistics			**Panel B.** Cross Correlation		
	Fairly important	**Very Important**	**Total**	**New Product**	**Upgrade**	**Invest in R&D**
Pressure from domestic competitor	38.37	21.46	59.83	0.0559***	0.0559***	0.0093
Pressure from domestic competitor	21.4	11.99	33.39	0.0846***	0.0594***	0.0801***
Pressure from customer	28.16	23.25	51.41	0.0729***	0.0566***	0.0507***

Note: The symbols ***, **, * mean that the coefficient is statistically different from zero, respectively, at the 1-, 5-, and 10- percent levels.

Table 7. The effect Human Capital on Innovation

	Panel A. University Education				**Panel B.** Management Experience			
	New product	**Upgrade**	**Invest in R&D**	**Index2**	**New product**	**Upgrade**	**Invest in R&D**	**Index2**
University education	*0.0020****	*0.0012****	*0.0012****	*0.0046****	---	---	---	---
	[0.0004]	*[0.0004]*	*[0.0003]*	*[0.0009]*	---	---	---	---
Manager Experience	---	---	---	---	*0.0022***	*0.0024****	*0.0007*	*0.0064****
	---	---	---	---	*[0.0009]*	*[0.0009]*	*0.0006*	*[0.0011]*
Age	0.0013*	0.0009	0.0008	0.0031**	0.0011	0.0008	0.0007	0.0027
	[0.0007]	[0.0007]	[0.0005]	[0.0017]	[0.0007]	[0.0007]	[0.0005]	[0.0017]
Medium	0.0504**	0.0530***	0.0464***	0.1418***	0.0466**	0.0507**	0.0450***	0.1321***
	[0.0217]	[0.0205]	[0.0161]	[0.0488]	[0.0216]	[0.0206]	[0.0161]	[0.0487]
Large	0.0671***	0.0374	0.1035***	0.1494***	0.0661***	0.0362	0.1036***	0.1449**
	[0.0257]	[0.0239]	[0.0211]	[0.0575]	[0.0256]	[0.0231]	[0.0212]	[0.0574]
Capacity utilization	0.0005	0.0013***	0	0.0024***	0.0004236	0.0012***	-0.0001	0.0022***
	[0.0004]	[0.0004]	[0.0002]	[0.0008]	[0.0004]	[0.0004]	[0.0002]	[0.0008]
Domestic competition	0.0161***	0.0094**	0.0081***	0.0361***	0.0157***	0.0097**	0.0078***	0.0352***
	[0.0039]	[0.0038]	[0.0027]	[0.0089]	[0.0039]	[0.0038]	[0.0027]	[0.0089]
Foreign ownership	0.0013***	0.00142***	-0.00004	0.0036***	0.0015402***	0.0015***	0	0.0064***
	[0.0005]	[0.0005]	[0.0003]	[0.0011]	[0.0005]	[0.0005]	[0.0003]	[0.0011]
Pseudo R2	*0.05*	*0.0806*	*0.1097*	*0.0495*	*0.0564*	*0.0831*	*0.1172*	*0.0534*
Obs.	*3187*	*3187*	*3187*	*3187*	*3187*	*3187*	*3187*	*3187*

Note: The symbols ***, **, * mean that the coefficient is statistically different from zero, respectively, at the 1-, 5-, and 10- percent levels.

ANNEX

Table A.1. Sample statistics

	Number of firms	Percent in Total	Cumulative percent
Albania	175	5.49	5.49
Azerbaijan	380	11.92	92.66
Kazakhstan	543	17.04	80.73
Kyrgyz Republic	234	7.34	100
Tajikistan	355	11.14	16.63
Turkey	1,134	35.58	52.21
Uzbekistan	366	11.48	63.7
Total	***3,187***	***100***	