ESSAYS ON MACROECONOMICS, ENTREPRENEURSHIP AND RETURNS TO KNOWLEDGE

Thesis submitted for the degree of
Doctor of Philosophy
at the University of Milan

by

Maksim Belitski
Department of Economics, Corporate and Statistical Sciences
University of Milan

Number of words: 40,984

2011

ESSAYS ON MACROECONOMICS, ENTREPRENEURSHIP AND RETURNS TO KNOWLEDGE

Maksim Belitski

ABSTRACT

The first essay studies the effects of exogenous and endogenous shocks on output sustainability in Central Eastern Europe and Russia during the 2000s. It expands traditional vector autoregressive model to a multi-country model that relates bank real lending, the cyclical component of output and spreads and accounts for cross-sectional dependence across the countries. Impulse response functions show that exogenous positive shock lead to a drop in output sustainability for nine over twelve Central Eastern European countries, when the endogenous shock is mild and ambiguous. Moreover the effect of the exogenous shock is more significant in the aftermath the crises.

The second essay investigates variation in entrepreneurship across cities of Commonwealth of Independent States (CIS) during 1995-2008, utilizing a unique dataset and employing the System Generalised Method of Moments technique. Institutional theory is used to unveil the effects of various institutional domains on heterogeneity of entrepreneurship across CIS cities. The findings suggest that banking reform facilitates entrepreneurship, whereas the size of the state discourages it. We also find that cities with higher number of universities are likely to have higher entrepreneurial entry, with the effect reinforced further through university-industry collaboration which highlights the importance of the knowledge spillover channel.

The third essay aims to assess the returns to patenting and knowledge expenditure in the form of innovative training and education for a matched Community Innovation Survey database (CIS) with the Business Survey Database (BSD) of 4049 UK firms. It also quantifies the incentives that patent protection provides for training expenditure. Controlling for additional firm-specific and industrial characteristics, patent and training premia were estimated viz. the additional new product revenues generated by obtaining a patent and by increase in spending on innovative training. Both patent and training premia are positive, however, there is no inducement for additional knowledge expenditure for a patent holder as expected from the literature. Returns to training vary across firms of different age and during the economically-constrained times: higher returns on training during the crisis and lower returns before the crisis. The study fills a gap in calculation of returns to knowledge, patent propensity for the UK innovators, and the impact of patent protection on further investment in knowledge.

ACKNOWLEDGEMENTS

First, I would like to thank my supervisor Professors Giorgio Barba-Navaretti and Professors Franco Donzelli, Michele Santoni and Alessandro Missale from the University of Milan who made my PhD study in Italy possible; for their support, guidance, inspiration, understanding and encouragement over the years that it has taken to complete my thesis.

My friends and paper co-authors Dr. Jana Peliova from the University of Economics in Bratislava, Dr. Julia Korosteleva and Prof. Tomasz Mickiewicz from School of Slavonic and Eastern European Studies, University College London and Dr. Yulia Rodionova from Leicester Business School who have been tireless in their reading of drafts and guiding me through my analysis, for which I am very grateful.

DECLARATION

Some of the material contained in this thesis has been presented in the following publications:

Chapter 1.

Journal Papers:
1. Belitski, M., Péliová, J., 2011. Output Sustainability to Exogenous and Endogenous Shocks: Evidence from Emerging Economies. International Journal of Sustainable Economy 3(3), 255-280
2. Belitski, M., Péliová, J., 2009. Analysis of ad-hoc monetary shocks in Central and Eastern Europe (Analýza ad-hoc monetárnych šokov v strednej a východnej Európe), Nová ekonomika: vedecký časopis Národohospodárskej fakulty Ekonomickej univerzity v Bratislave = Faculty of National Economy, University of Economics in Bratislava scientific journal = The New economy. - Bratislava: EKONÓM, 2009. - ISSN 1336-1732. - Roč. 2, č. 3, s. 86-99. (published)

Chapter 2.

Journal Papers:
Belitski, M. and Korosteleva, J. (2011) Entrepreneurship and cities: Evidence from post-communist world, WIFO Working Papers, 2011. Available at http://www.icsb2011.org/download/18.62efe22412f41132d41800011708/74.pdf

Books:
Belitski, M. 2010. Foreign direct investment in innovation: policy coordination in regional unions. In Rudenkov, V. (Ed.). International business vectors (pp.308-318). Minsk: Institute of Economics. Publisher Law & Economics. (published)

Chapter 3.

Report:
Arora, A, Athreye, S., and M. Belitski. 2011. Returns to patenting. Report on IPO UK project 'Patent incentives' No 11004, IPO UK September 2011.

List of contents

List of Figures page

List of Tables page

Chapter 1. Output Sustainability to Exogenous and Endogenous Shocks: Evidence from Emerging Economies[1]

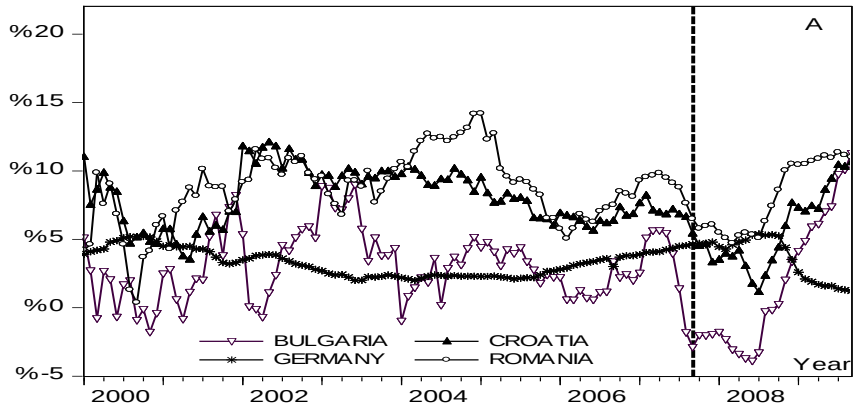
1.1. Introduction

Sustainable economic development programmes of the former Soviet bloc countries were suddenly brought down by a severe economic downturn starting from the beginning of 2008. One by one the economies were affected with downturn of output, lack of internal and external funds for government and business. Output, private credit to GDP, jobs, stock prices fell dramatically with large capital outflows from the Central Eastern Europe and Russia. The purpose of this paper is to build a multi-country model for thirteen Central and Eastern European countries (Croatia, Romania, Bulgaria, Slovakia, Czech Republic, Poland, Hungary, Lithuania, Latvia, Estonia, Russia, Slovenia and Ukraine) structured as a panel data model and to estimate the impact of external (exogenous[2]) and domestic (endogenous) shocks on output sustainability in these countries over a period of 2001-2009. A particular focus is on establishing the differences in the output response to shock within 2001-2009 and in the aftermath of financial crises (2007-2009).

The cointegration relationships between the variables of interest was not modelled here, as for the newly established countries like Croatia, Latvia, Lithuania, Estonia, Ukraine and other, or substantially transformed Russia, the long-run relationships have time to develop (Charamza et al. 2009). Regarding the reduction of the dimensionality problem, cross-country augmentations, discussed by Chudik and Pesaran (2007, 2009) and Charamza et al. (2009) were originally implemented in the Infinite vector autoregressive model (IVAR). This model has shown the consistency of the cross-country augmentations in case where the number of countries is large and there is no dominant country in the panel Chudik and Pesaran (2009).

We model endogenously generated shocks, as a temporary increase in the risk premium faced by domestic borrowers —that is, an increase in a real lending rate. The dynamic of the real lending rate fluctuations is shown in Figure 1.1. The dotted vertical line corresponds to the beginning of the world financial crisis (Sept. 2007). Real lending rates in Germany are given for a benchmark.

Approach to modelling external shock is motivated in large part by the increase in US corporate bond yield spread i.e. change of Moody's BAA Corporate Bond Yield relative Moody's AAA Corporate Bond Yield[3], see Figures 1.2. The indicator is sometimes called Moody's BAA-AAA default spread. A vertical line corresponds to the beginning of the world financial crisis (Sept. 2007).



[1] This essay is the result of collaboration with Professor Jana Péliová from the Economic University in Bratislava (Slovakia) during my stay in Bratislava and Professor Alessandro Missale during 2010-2011 in Milan.

[2] Exogenous shock is used interchangeably with external shock; endogenous shock is used interchangeably with domestic shock.

[3] Moody's BAA Corporate Bond Yield and Moody's AAA Corporate Bond Yield series are seasonally adjusted.

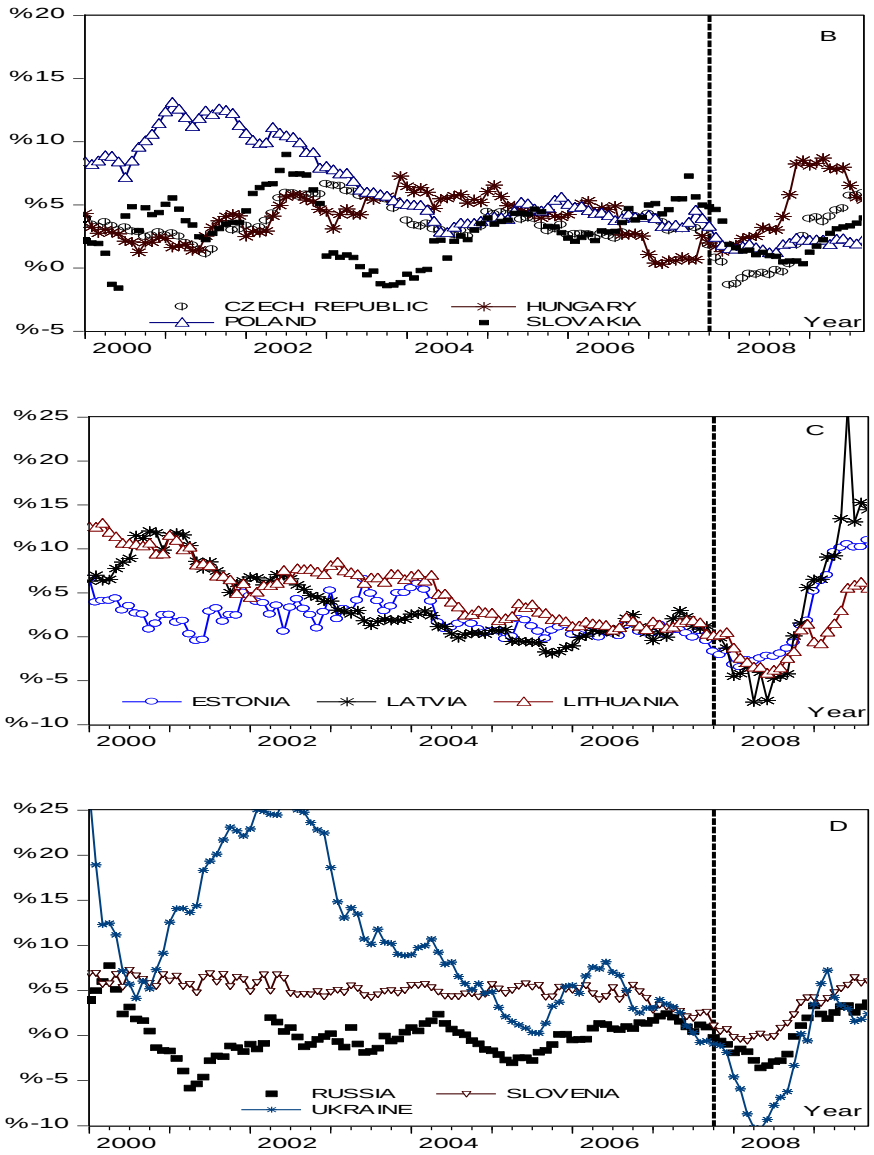


Figure 1.1 Real lending rates: Croatia, Romania, Bulgaria and Germany (A); Slovakia, Czech Republic, Poland, Hungary (B); Lithuania, Latvia and Estonia (C); Russia, Slovenia and Ukraine (D), Jan. 2000- Oct. 2009

Sources: Datastream; IMF International Financial Statistics; National Bank of Ukraine for Ukraine wired http://www.bank.gov.ua/Statist/sfs.htm and Deutsche Bundesbank for Germany wired http://www.bundesbank.de/statistik/statistik_zeitreihen.en.php; Croatian Central Bureau of Statistics for Croatia wired http://www.dzs.hr/default_e.htm

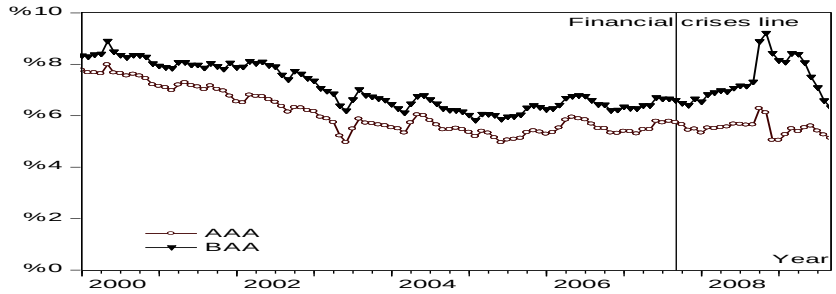


Figure 1.2 Moody's yields on corporate bonds – all industries, AAA and BAA, Jan. 2000- Oct. 2009

Source: www.moodys.com

Like yields on Treasury securities, US corporate bond yields spread embody a reward to investors for forgoing consumption today and saving. But corporate yields are almost always higher than yields on Treasuries of comparable maturities because of the implicit default risk and a host of other factors. The US corporate bond yield spread is also used as a measure of credit stress. It signifies the degree of risk-aversion of a lender. Widening the gap between BAA and AAA corporate bond yields signifies that lenders have become extremely risk-averse.

Evidence on the predictive ability of the external shocks on economic performance proxied by output gap of the country, would be useful to businesses and policymakers. These countries present new business opportunities for European companies. For example, European businesses and policy-makers would benefit from better forecasts of foreign real economic activity because projections for European counties exports depend on forecasts of foreign economic growth.

We find that variance decompositions and impulse responses corrected for cross-country interdependence demonstrated that output gap associated both with external and internal shocks is growing faster in short horizons, which signifies an immediate impact of a shock to business activity in the economies analysed. The impact of external shock as an indicator of external investor's risk-aversion in the aftermath of crises was clearly higher in 2007-2009 compared to 2001-2009 for the majority of the countries with few exceptions.

The external shocks associated with a decrease of a risk appetite of international investors were a threat to economic sustainability brining down economic performance in a short run, in particular for Czech Republic, Hungary, Latvia, Lithuania, Russia and Slovenia; in a long run for Estonia, Poland and Slovakia. Romania and Bulgaria seem to behave even which could be explained by existence of investment mechanisms for these countries and large foreign direct investments.

The plan of this paper is as follows. Section 1.2 presents the theoretical framework and establishes research hypothesis. Section 1.3 presents Infinite VAR model (for the period January 2001 – October 2009)**.** Variance decompositions are discussed in section 1.4. Section 1.5 uses impulse response functions to analyse the effects of external shocks, defined as an increase in the US corporate bond yields spread; and of domestic shock defined as an increase in the real lending rate. Section 1.6 assesses the movements in output in the aftermath of financial crises 2007–2009. Section 1.7 concludes.

1.2. Theoretical framework and hypothesis tested

The theoretical framework is based on the works of Gilchrist et. al. (2009) and works of Federal Reserve bank of St. Louis emphasizing the fact that US corporate bond yields spread contain substantial predictive power for economic activity and outperform—especially at longer horizons—standard default-risk indicators. Much of the predictive power of bond spreads for economic activity is embedded in securities issued by intermediate-risk rather than high-risk firms. According to impulse responses from a structural factor-augmented vector autoregression model proposed in their paper, unexpected increases in corporate bond spreads cause large and persistent contractions in economic activity.

Famous studies in this field, but not for transition economies include Genberg (2003) on of output fluctuations and risk premiums. Using variance decompositions, he finds that external shocks are important determinants of movements in the level of prices and GDP. Furthermore, Genberg and Sulstarova (2008) incorporated the assessment of sovereign debt sustainability and showed how the volatility of the macroeconomic variables as well as potential interactions between them influence country risk. Gilchrist et. al. (2009) analysed the impulse responses from a structural factor-augmented vector autoregression, where unexpected increases in corporate bond spreads cause large and persistent contractions in economic activity. They have proved that shocks emanating from the corporate bond market account for more than 30 percent of the forecast error variance in economic activity in the US at the two- to four-year horizon. Overall, their results imply that credit market shocks contributed significantly to US economic fluctuations during 1990–2008.

The determinants of output sustainability theories for developed and developing world were discussed extensively by Agénor and Aizenman (1998), Barajas, Steiner and Salazar (1999), Demirgüç-Kunt and Huizinga (1999), Afanasieff, Priscilla and Nakane (2002), McMillan (2002), Mody and Taylor (2003, 2004), Botric and Slijepcevic (2008), Papadamou S. (2009), Gilchrist et. al (2009). At the same time scarce research has been done so far on the impact of exogenous shocks (proxied by yields on a BAA corporate bond and AAA corporate bond of comparable time to maturity) on economic activity in transition economies of CEE. This paper aims to bridge this gap along with estimating the effect of external shocks on economic activity over the period of 2001-2009 and in aftermath of financial crises 2007-2009. Taking into account that the spreads are mainly driven by global financial conditions (e.g. Agénor, Aizenman and Hoffmaister, 2008; Özatay, Özmen and Şahinbeyoğlu, 2009), transition economies of CEE in spite of the declared sustainable economic growth are sensitive to exogenous shocks in international credit and equity markets. Understanding the way external shocks affect outputs is relevant for monetary and fiscal policy implications in these countries, which could enable policy makers to use the most sophisticated financial and monetary instruments. The aspect that is in the focus relates to the direct impact of shocks on business that finance their capital needs via domestic / international banking system. Therefore, the research hypotheses to be tested are following:

Definition 1: A higher external cost of credit, r_i^* *due to increase in the risk premium nationally or internationally, raises the price of money (domestic real lending rate), therefore lowers the demand for inputs and business activity, and reduces expected aggregate output in the economy.*
Definition 2: A higher BAA-AAA corporate bond yields spread will signify that lenders are becoming extremely risk-averse and dislike risk. Therefore lenders are expected to stay away from adding high-risk stocks or investments to their portfolio linked to the economies with the increased default risks. Negative response of output gap to a shock to BAA-AAA corporate bond yields spread explains that the lenders are cautious about their investment or stocks market operations in the country in focus. The contrary is true for positive response of output gap to BAA-AAA corporate bond yields spread shock.

Results in Definition 1 and 2 are consistent with those obtained with more developed, general-equilibrium models, such as those of Neumeyer and Perri (2005) and Gilchrist et al. (2009). There are crucial differences between the model developed by Neumeyer and Perri (2005) and our studies. Their framework is nonmonetary in nature, so that capital needs to depend on real interest rates. In our model, where firms and government borrow from home and international markets, domestic lenders are assumed to receive back the full value of their loans (plus interest) making borrowing risk free. The banking system and credit market are explicitly considered here. However, this is done in a deterministic setting with no account of credit market imperfections.

1.3. VAR Estimation and Analysis

Panel data sets are likely to exhibit substantial cross-sectional dependence, which may arise due to the presence of common shocks and unobserved components that become part of the error term. See, for example, Robertson and Symons (2000), Pesaran (2004) and Baltagi (2008). One reason for this development for transition countries may be that during the last decade transition countries experienced an ever-increasing economic and financial integration reuniting into EU, which implies strong interdependencies between countries.

Assuming that cross-sectional dependence is caused by the presence of common factors, which are unobserved they are uncorrelated with the included regressors, the standard fixed effects (FE) and random effects (RE) estimators are consistent, although not efficient, and the estimated standard errors are biased. One may chose to rely on standard FE/RE methods and correct the standard errors by following the approach proposed by Driskoll and Kraay (1998). Alternatively, one may attempt to obtain an efficient estimator by using the methods put forward by Robertson and

Symons (2000) and Coakley and Fuertes (2002) dealing with asymmetric dynamics in UK real interest rates. On the other hand, if the unobserved components that create interdependencies across countries are correlated with the included regressors, these approaches will not work and the FE and RE estimators will be biased and inconsistent.

One may follow the approach proposed by Pesaran et. al. (2004), Chudik and Pesaran (2007, 2009, 2010) to deal with cross-sectional dependence in both cross-section and time series. They have introduced the so-called "stacked vector autoregressive model (VAR)" which is different from a simple VAR. Simple VAR is a model for two or more time series where each variable is modelled as a linear function of past values of all variables, plus disturbances that have zero means given all past values of the observed variables. VAR models will have at least one lag of each variable. All variables in VAR model are normally assumed to be endogenous, however it does not mean there could not be an exogenous variable in the VAR. In practice there would often be more than two endogenous variables, but not necessarily an exogenous variable. In case with N endogenous variables and l lags, we can write VAR model in a matrix notation such as:

$$x_t = \alpha + \Gamma_1 x_{t-1} + \cdots . + \Gamma_t x_{t-l} + \varepsilon_t \qquad (1.1)$$

where α vector of intercept term, x_t it's a lagged value, ε_t are N x 1 vectors, Γ_1,…. Γ_l are N x N matrices of constants to be estimated.

Although the approach has drawbacks, such as a lack of economic restrictions on the dynamics of the system (Cooley and Dwyer, 1998) and sensitivity to identifying restrictions (Pagan and Robertson, 1998; Faust and Leeper, 1997), it has the advantage of being able to capture general dynamic relationships and identifying economic interactions without the imposition of too much structure. However, one of the weak points of this approach in practice is that the need for a limited number of endogenous and exogenous variables which could lead to omitted bias. As the number of parameters, to be estimated grows at a quadratic rate, the number of variables is limited by the size of typical country datasets. For macroeconomic and international economics empirical applications this is not enough. As the number of cross-sectional units' increases we face the so-called "curse of dimensionality", and certain restrictions must be imposed for the analysis.

Two different approaches have been suggested in the literature: (i) shrinkage of the parameter space and (ii) shrinkage of the data. They consider a parameter space can be shrunk by imposing a set of restrictions, which could be for instance obtained from a theoretical structural model, directly on the parameters. The second approach to deal with "curse of dimensionality" is to shrink the data, along the lines of index models. Chudik and Pesaran (2007, 2009 and 2010) techniques model proposes to deal with the curse of dimensionality by shrinking the data as the number of endogenous variables (N) increases to a large number. Under this set up their Infinite VAR (IVAR) could be approximated by a set of finite-dimensional small-scale models that can be consistently estimated separately in the spirit of Global VAR (GVAR) models initially proposed in Chudik and Pesaran (2007).

Later on, Chudik and Pesaran (2010) extend the analysis of infinite dimensional vector autoregressive models (IVAR) proposed to the case where one of the variables or the cross section units in the IVAR model is dominant or pervasive. This extension is not straightforward and involves several technical difficulties. The dominant unit influences the rest of the variables in the IVAR model both directly and indirectly, and its effects do not vanish even as the dimension of the model (N) tends to infinity. The dominant unit acts as a dynamic factor in the regressions of the non-dominant units and yields an infinite order distributed lag relationship between the two types of units. Despite this it is shown that the effects of the dominant unit as well as those of the neighbourhood units can be consistently estimated by running augmented least squares regressions that include distributed lag functions of the dominant unit.

A successful attempt to extend Chudik and Pesaran's logic on modelling the transition economies of Belarus, Ukraine and Russia was made by Charemza et. al. (2009). Technically their the modelling idea has been grounded within the concept of the infinite dimensional vector autoregressive models by Chudik and Pesaran (2007). The main developments are such that the

model is 1) interdependent rather than vector autoregressive, 2) estimated by the generalised method of moments and 3) forward-looking. The primary linkage of the country models is provided through the real effective exchange rates of particular countries, while the secondary linkages are through the Chudik and Pesaran cross-sectional augmentations. Cross section augmentations (CSA) i.e. cross section averages of each endogenous variable calculated for the rest the countries. CSA itself is an exogenous variable which captures the effect of cross-sectional dependence across the countries caused by the presence of common factors, which are unobserved. An Infinite VAR along with a simple VAR method enable to measure the impact of external and domestic shocks on output of one country taking into account an unobserved impact of the rest of the countries pooled together in one vector autoregressive model. Both VAR and IVAR models may have the number of lags starting from one and more. In case with N endogenous variables and l lags, the Infinite VAR model can be represented as follows:

Let x_{it} denote the realisation of a random endogenous variable belonging to cross section unit i in period t, and assume that $x_{it} = (x_{1t}, x_{2t} \dots, x_{Nt})$ is generated according to the following reduced VAR (l) model:

$$x_{it} = \alpha + \sum_{l=1}^{p} \Gamma_{pi}\, x_{i,t-l} + \sum_{l=0}^{q} \theta_{q\,i}\, x^{*}_{t-l} + \mu_{it} \qquad (1.2)$$

where, α vector of intercept terms, Γ_p is N x N dimensional matrix of unknown coefficients of the endogenous variables, θ_q is N x N dimensional matrix of unknown coefficients of cross-section augmentations (CSA), significant in a group cross- section augmented regressions, $\mu_t = (\mu_{1t}, \mu_{2t}, \dots \dots \dots, \mu_{Nt})$ are white noise innovation terms, that is E(μ_{it})=0, and , μ_{it} and , μ_{it+h} are independent for , h= 0. The matrix $\sum_{\mu}(\mu\acute{\mu})$ is non-diagonal.

Country specific cross section averages accounting for cross-sectional effects, are constructed as

$$x^{*}_{it} = \sum_{j=1}^{N} x_{jt} \qquad (1.3)$$

CSAs (1.8) are included in a VARs model as exogenous should the value of θ_{qi} be more than zero for $l \in \{0, \dots, q\}$.[4]

IVAR now includes the following variables: US corporate bond yield spread, BAA-AAA, domestic interest rate spread on national currency-denominated assets and liabilities, DS, real lending rate, LR, and measure of output gap, GAP, i.e. economic performance of the country: deviations of current output from its trend level, $((y_{real} - y_{pot}) / y_{pot})$. The trend component y_{pot} is obtained by applying the moving average[5] instead of Hodrick–Prescott filter frequently used in economic literature[6]. In order to justify the inclusion of CSA in IVAR (p) model cross-sectional dependence test (CD test) by Pesaran (2004) was implemented and those CSAs to be included in a model were identified (see Table 1.1 below). US corporate bond yield spread was not tested for CD dependence as this variable is exogenous and does not vary across the countries being analysed. No CSA were calculated for US corporate bond yield spread. Pesaran CD test strongly rejects the null hypothesis of no cross-sectional dependence at least at the 1% level of significance. Although it is

[4] On the previous version of the paper distances between the capitals of country *j* and country *i* used for to implement unobserved effects correction. We reconsidered this approach and we agree with the anonymous referee that such an approach is not suitable for financial market analysis as the markets are becoming or are already global. Therefore distances as weights were removed from cross sectional augmentations.

[5] Simple moving average (one sided) was used in its unweighted mean of the previous 7 data points. For example, a 7-months simple moving average of output is the mean of the previous 7 months' output.

[6] The filter has misleading predictive outcome when used dynamically since the algorithm changes (during iteration for minimisation) the past state (unlike a moving average) of the time series to adjust for the current state regardless of the size of lambda used.

not the case here, a possible drawback of the CD test is that by adding up positive and negative correlations it might undermine the cross-sectional dependence present in the data.
The average absolute correlations are calculated between the cross-sectional units. In this case the average absolute correlations are 0.680, 0.095 and 0.135 respectively. The value of GAP is very high. Hence there is enough evidence suggesting the presence of cross-sectional dependence in model (1.2) under a fixed effects assumption.
To justify the choice of four variables in a model two correlation matrices were introduced (see Table 1.2 and Table 1.3). Table 1.2 and 1.3 provide the evidence of existing correlation between the model variables. Particular attention is given to proxies for shocks and a dependent variable output gap. As one could expect the correlation is statistically significant and the value of the pair-wise correlation coefficient is lower for US corporate bond spread. The pair-wise correlation coefficient between US corporate bond spread and output gap increases three times during the time of crises which helps us to explain better fluctuations in output gap of those economies of international lender's interest. Both coefficients are statistically significant at 1% significance level; however correlation does not mean causation.

Table 1.1: Pesaran CD test of cross-sectional dependence*

Model: Fixed effects (within) regression	Pesaran's test of cross sectional independence	Pr.	Average absolute value of the off-diagonal elements
GAP as dependent variable	57.880	0.000	0.680
LR as dependent variable	4.445	0.000	0.095
DS as dependent variable	5.329	0.000	0.135

*Note: According to the results, once we account for State fixed effects LR and DS have no effect upon country output fluctuations. An assumption implicit in estimating equation (1.2) is that the cross-sectional units are independent. Ho: Cross-sectional Independence. To test this hypothesis Pesaran's (2004) CD test was employed.
Source: Author's calculations.

The pair-wise correlation coefficient of real lending rate and output gap has also increased significantly during the time of crises and became negative. This signifies a higher impact of lending rates hit by endogenous shocks and its effect on output of the countries being analysed.

Table 1.2: Correlation matrix of model variables (Feb. 2007- Sept. 2009)

	Interest rate spread	BAA-AAA	Output gap	Real lending rate
Interest rate spread	1.0000	-	-	-
BAA-AAA	-0.1108* (0.001)	1.0000	-	-
Output gap	0.0234 (0.361)	-0.0603** (0.018)	1.0000	-
Real lending rate	0.0834* (0.001)	-0.0165 (0.520)	0.1217* (0.000)	1.0000

(*), (**), (***)-significant at 1, 5 and 10% level accordingly, p-values are in parenthesis. Number of observations 105.
Source: Author's calculations.

We refer in what follows to the model without CSA as Model A, and the one with CSA as Model B. Both models are estimated with monthly data from January 2001 through September 2009. External shocks being exogenous to both domestic factors (such as changes in output and domestic credit conditions) and external factors (such as changes in market sentiment) are therefore placed last in the Cholesky ordering of the IVAR model. This allows to "clear" it of its possible domestic component. In doing so, we are capturing primarily the exogenous shock. Changes in a real lending rate could happen mostly due to endogenous shocks, such as changes in government bond rates, monetary

policy and other domestic credit conditions. Therefore that variable is placed first in the ordering of the IVAR model as it will include the domestic component.

Table 1.3: Correlation matrix of model variables in crises (Feb. 2007- Sept. 2009)

	Interest rate spread	BAA-AAA	Output gap	Real lending rate
Interest rate spread	1.0000	-	-	-
BAA-AAA	-0.0664 (0.146)	1.0000	-	-
Output gap	0.1614* (0.004)	-0.1978* (0.000)	1.0000	-
Real lending rate	-0.6345* (0.000)	0.1723* (0.001)	-0.2921* (0.000)	1.0000

Note: (*), (**), (***)-significant at 1, 5 and 10% level accordingly, p-values are in parenthesis. Number of observations 33.
Source: Author's calculations.

1.4. Variance Decompositions

The variance is used as a measure of how far a set of numbers are spread out from each other. It is one of several descriptors of a probability distribution, describing how far the numbers lie from the mean (expected value). In particular, the variance is one of the moments of a distribution.

Variance Decomposition or Forecast error variance decomposition indicates the amount of information each variable contributes to the other variables in VAR models. To analyse variance decomposition is important because it determines how much of the forecast error variance of output gap can be explained by exogenous shocks to the other variables and the output gap itself.

Table 1.4 presents for Model A and Model B the variance decompositions for GAP. Following the discussion of the results below, the table shows the share of the variance associated with shocks to GAP, and the sum of the shares of the variance associated with shocks to the other variables in the models[7].

The share of the variances in Model A and Model B are different. At face value these results suggest that on average between January 2001 and October 2009, movements in GAP for the countries being analysed were associated with shocks originating from both outside and inside the country. This was not true for Lithuania, Croatia, Czech Republic and Estonia.

The bulk of the variance of GAP is associated with external shocks proxied by BAA-AAA spread for Latvia, Slovenia, Romania and Russia. This signifies that the external lenders and international credit markets, US in particular play an important role for the above countries. This effect is true for both short and long horizons, where the external shocks are associated with more than 30 percent of the GAP variance for Latvia, 21 percent for Slovenia, more than 40 percent for Romania and about 20 percent for Russia. Although this share declines somewhat from 6 to 12 months.

The share of the variance of the cyclical component of output associated with domestic shocks proxied by LR is not as substantial as was expected. The variance of GAP for Latvia, Slovenia, Hungary and Ukraine is explained by shocks originating within the country such as real lending rate shock. Although the specifics depend on the choice of GAP measure, the share of the variance of GAP associated with LR increases within 6-20 month horizon for Hungary, Ukraine, Latvia, Lithuania, Slovakia and Romania; increases within 1-6 months for Poland, Estonia, Slovenia, Bulgaria, Croatia. In fact the first group of countries are seemed to be the most effected by Global financial crises in 2007-2009.

1.5. Impulse response analyses

[7] The shocks are assumed to be orthogonal; therefore, the sum of the shares reflects the combined shares of the variance associated with shocks from BAA–AAA, DS, (y - $y$pot / $y$pot) and LR. Also, it avoids the thorny issue of identifying the individual shocks of these variables that are not of interest to this study.

Figure A.1 in Appendix A (left column) shows the impulse responses of GAP to a positive shock from BAA-AAA, when (right column) shows the impulse responses of GAP to a positive shock from LR. Impulse response functions describe how the GAP reacts over time to exogenous impulses, which economists usually call 'shocks'. These impulse responses have been computed by placing BAA-AAA last in the ordering and by placing LR first in the ordering in case of calculating the effect of a shock from LR. Placing LR first in the ordering does not purge the identified LR shock from the impact of other shocks in the model that are more likely to reflect domestic factors. As discussed in the introduction, the experiment of placing the variable last in Cholesky ordering can be viewed as reflecting a "pure" contagion effect, triggered by events taking place elsewhere. A shock from BAA-AAA was identified, but not for a shock from LR.

The shock from LR cannot be now viewed as reflecting an adverse external financial shock—related or not to contagion[8]. The figure displays one-standard-error bands of a percentage change for GAP and one standard deviation for BAA-AAA or LR variable[9].

Table 1.4: Variance decompositions of "Cyclical component of output" (Model A and Model B) over the period 2001:M1-2009:M9

Country	Months	Percentage of variance associated with historical shocks from:							
		Model A (VAR)				Model B (IVAR)			
		GAP	LR	DS	BAA-AAA	GAP	LR	DS	BAA-AAA
Poland	1	99.94	0.00	0.04	0.00	99.75	0.03	0.20	0.00
	6	85.84	8.86	1.49	3.79	79.29	5.40	3.32	11.96
	20	82.77	9.21	3.34	4.66	73.36	5.70	6.16	14.47
Czech Republic	1	99.97	0.00	0.02	0.00	99.41	0.06	0.51	0.00
	6	81.81	1.31	3.59	13.27	87.94	0.49	5.11	6.45
	20	78.90	3.30	4.95	12.83	78.43	1.96	11.10	8.49
Slovakia	1	99.40	0.00	0.59	0.00	99.63	0.36	0.00	0.00
	6	93.43	0.97	4.16	1.42	95.05	0.44	3.50	1.00
	20	90.23	2.44	4.04	3.27	69.00	5.44	14.40	11.14
Hungary	1	97.05	2.88	0.06	0.00	98.37	1.47	0.14	0.00
	6	84.12	6.62	0.24	9.00	80.29	11.49	0.62	7.58
	20	82.00	8.26	1.00	8.72	48.18	39.45	1.48	10.87
Lithuania	1	99.95	0.04	0.00	0.00	92.53	0.95	6.50	0.00
	6	65.68	17.25	8.43	8.63	75.03	1.74	18.92	4.29
	20	69.09	15.78	7.41	7.70	70.11	4.96	19.85	5.06
Latvia	1	99.97	0.01	0.00	0.00	98.13	1.74	0.11	0.00
	6	74.46	0.66	2.39	22.47	55.21	12.25	1.57	30.95
	20	74.40	1.35	2.30	21.93	45.75	24.58	2.88	26.77
Estonia	1	95.28	3.56	1.15	0.00	98.21	1.42	0.36	0.00
	6	70.55	3.34	3.78	22.30	90.32	3.38	0.54	5.74
	20	63.86	4.19	8.36	23.57	87.45	3.72	1.63	7.18
Slovenia	1	96.84	0.09	3.06	0.00	94.00	5.53	0.45	0.00
	6	72.82	7.70	5.74	13.72	46.93	28.97	6.95	17.12

[8] In the context of transition countries, the shock from *LR* that is considered may well also represent an increase in devaluation risk. In fact, accounting for the transmission process of a change in devaluation expectations would require taking into account the fact that major part of the firms could have large foreign-currency-denominated liabilities. But to the extent that adverse balance sheets effects translate into downward movements in the cyclical component of output—because, for instance, the risk premium depends on firms' net worth, Bernanke, Gertler and Gilchrist (2000) —empirical framework would implicitly capture it.

[9] In all figures the dotted lines for the impulse responses (IRs) show one-standard-error band in each direction and are based on 1000 Monte Carlo replications. The upper dotted line shows the upper border of possible response of *GAP* to a shock from *BAA-AAA* or *LR*. The bottom dotted line shows the lowest border of possible response of GAP to a shock from *BAA-AAA* or *LR*. The reaction to shock may vary within the upper and bottom dotted lines which are also called 95% confidence intervals, i.e. with 95% confidence it's possible to say the response of *GAP* will fit to the estimated dotted corridor. Should upper or bottom dotted line cross zero line we conclude on zero response of *GAP* to an exogenous shock. In each replication we sampled the VAR coefficients and the covariance matrix from their posterior distribution. From these repetitions we calculated the square root of the mean squared deviation from the impulse response in each direction. By construction, these bands contain the impulse-response function but are not necessarily symmetric. Number of observations are 117.

	20	63.77	6.73	10.82	18.66	40.47	25.18	12.97	21.36
Romania	1	99.65	0.11	0.23	0.00	97.66	1.03	1.30	0.00
	6	87.42	8.08	3.89	0.59	52.02	3.43	4.96	39.58
	20	86.53	7.02	4.35	2.08	42.30	9.95	4.15	43.57
Bulgaria	1	99.98	0.01	0.00	0.00	97.47	2.50	0.01	0.00
	6	88.49	2.65	4.56	4.28	84.60	9.39	5.40	0.58
	20	87.75	2.95	3.34	5.95	73.79	10.03	6.24	9.92
Croatia	1	92.51	7.20	0.27	0.00	95.93	4.05	0.00	0.00
	6	81.68	13.63	0.59	4.08	92.39	5.36	0.60	1.63
	20	83.08	10.48	0.79	5.63	90.97	5.70	1.39	1.92
Russia	1	94.88	0.00	5.11	0.00	95.59	3.71	0.69	0.00
	6	86.81	4.69	4.78	3.70	80.78	2.44	0.65	16.11
	20	85.73	5.85	4.07	4.34	75.01	4.10	1.11	19.77
Ukraine	1	94.59	0.91	4.49	0.00	97.96	1.46	0.56	0.00
	6	88.98	1.42	8.52	1.06	91.70	4.34	6.39	7.55
	20	86.30	3.06	7.13	3.49	72.74	13.31	5.64	8.28

Notes: These decompositions in the Table 1.4 are based on the unrestricted VAR and Infinite VAR analysis described above following Chudik and Pesaran (2007, 2009, 2010). Variance decompositions are assumed to add up to 100 percent and historical shocks are considered to be orthogonal, which is different from the decompositions based on the generalized VAR analysis following Koop, Pesaran and Potter (1996). Variance decompositions are obtained from IVAR models with cross-sectional averages for DS, LR, GAP with cross section dependence in Model B. Standard -error in each series are based on 1000 Monte Carlo repetitions. The model is estimated with four lags using monthly data from 2001:M1 through 2009:M9; see Appendix A for details. Source: Author's calculations.

First, the impulse responses of GAP to a positive shock from BAA-AAA are discussed and later the impulse responses of GAP to a shock from LR. A shock from BAA-AAA corporate bond yield spread is modelled which supports the thesis that risk appetite has decreased, and investors do not intend to put money to work but rather park it in low risk reservoirs. If this happens, movements of GAP for most of the countries become significantly negative supporting the definition 2 of the paper. This holds true for Czech Republic, Estonia, Hungary, Latvia, Lithuania, Slovenia, Slovakia, Poland and Russia. The fall in the GAP is very significant for the economies dependent on international lending such as Hungary, Slovenia Latvia, Poland and Russia. This signifies that lenders stay away from adding high-risk stocks or investments to their portfolio linked to the economies with increased default risks.

On the contrary, GAP becomes significantly positive in case of Romania and Bulgaria which joined the European Union during its last enlargement in 2007. This positive response could be explained by low level of dependence on US investments, rather than EU investments. These two countries have recently become centres of outsourcing for European multinationals as well as the centres of emigration. Impulse response displays higher degree of persistence for those countries less dependent on US credit and financial markets such as Russia, where the fall has happened 4 months aftershock. At the same time there was a lower persistence to shock by Czech Republic, Estonia, Hungary and Slovenia (3 months). GAP falls instantly after the shock for Poland and Latvia[10]. Movements in GAP for Slovakia and Ukraine are ambiguous, because of the large one-standard-error bands. The instant aftershock possibly reflects other external shocks or a low share of stocks in the investor's portfolios from these two countries.

For seven of the thirteen countries the shock from LR does not result in any significant changes in GAP. The 95% confidence intervals include zero, which means there is no significant effect of a shock from LR on GAP. Moreover, for four countries such as Hungary, Latvia, Russia and Ukraine, GAP become significantly positive which is counterintuitive to the definition 2 made in the paper. The possible explanation for this is that firms do not lend in national currency due to high inflationary expectation and constant depreciation shocks. These shocks might affect business which starts borrowing money in more stable currencies such as Euro or US dollar. In this case there is nothing surprising in the positive response of GAP to a shock from LR, should there be an international credit channel open. It may also reflect, financial speculation happening behind the

[10] Note that there are no perverse blips in the output response at any times. It is clear why the measurement of cyclical output in this case does not make such a blip. It is possible if the HP filter is used in the Model which may create a spurious cycle, as discussed by Cogley and Nason (1995). In our Model moving average of seven lags has been used which prevents any unexplained blips and spurious cycles.

scenes, recalling that LR is calculated as the nominal lending rate on national currency-denominated loans at a monthly rate minus current monthly inflation. Nevertheless, definition 2 holds true for Croatia, Slovakia and Hungary in the short horizons. This could be explained by borrowing primarily in national currency and absence of any form of financial tightening or constraints from the Central banks (e.g. a good example of financial market liberalisation is Hungary were no financial constraints exist). Movements in GAP for Bulgaria, Czech Republic, Estonia, Slovakia, Lithuania, Poland, and Romania are ambiguous, possibly because the finding of large one-standard-error bands for the instant aftershock that is a reflection of external shocks.

It's possible to conclude on heterogeneity in countries' responses to endogenous shocks. What is obvious is the size of the economy and monetary policy could explicitly affect the movements in GAP in favour of exogenous vs. endogenous shocks. The economies being analysed are small open economies except for the economy of Russia which is more subject to endogenous rather than exogenous shocks. Ambiguous impulse responses of GAP to a positive shock from LR for seven of the thirteen countries enable to conclude on high level of borrowing in foreign currency, economic openness, high inflationary expectations and depreciation shocks. The business does not seem to borrow in national currency to buy the inputs of production, so that the production cycle is not very much dependent on the national currency which often play a secondary role in transition economies of Central and Eastern Europe.

1.6. The Aftermath of Crisis: Variance Decomposition

A useful application of VAR models estimated above is to assess how much each variable contributes to the movements in output gap in VAR models. Variance Decompositions in the immediate aftermath of crisis (2007-2009) show how much of the forecast error variance of output gap can be explained by exogenous shocks during the crises, rather than during the entire period analysed. This can be done by using the historical variance decompositions of these variables for the period immediately following the collapse of world financial system, specifically, from September 2007 to September 2009. Table 1.5 presents these results on a monthly basis.

First Cogley and Nason (1995) and later Agénor, Aizenman and Hoffmaister (2008) proposed to use similar approach to estimate the effect of shocks for GAP in the aftermath of Peso crises, when the historical decompositions obtained by averaging over the monthly decompositions for unrestricted vector autoregressive models. The fact that the monthly data is already available in the model guarantees the outputs from Table 1.5 are consistent to those in Table 1.4. Above provides a clear interpretation of the results accounting for financial crises within the economies analysed.

Results for IVAR model in Table 1.5 indicate that the share of the variance of GAP associated with BAA-AAA shocks in the aftermath of crises (2007-2008) compared to the period of 2001-2009 has increased for the majority of countries. This is in line with the economic intuition. The more is the dependence of small open economies on international fundraising, foreign economic policy, foreign direct investment and export-import transactions, the higher is the risk of exogenous shocks. For the same period there is a fall in the share of the variance of GAP associated with BAA-AAA shocks in the aftermath of crises for Slovenia, Romania and Russia.

The above could be explained by specific economic structures of these countries. Slovenia is one of the most developed economies in the New EU member states. Its sustainable growth before the crises increased the level of country resistance to various exogenous shocks almost outside the EU. Like Romania and other New EU member states the country is being gradually integrated with European financial and credit institutions and is more dependent on shocks originating from inside the EU than from outside. The situation with Romania is different, however a stream of financial resources in a form of direct investments and outsourcing policy of multinationals, sustainable production and services growth, common trade zone within the EU made the country less dependent on FDI originating from outside the EU and the perception of a country's default by foreign investors.

Russia being a large open economy with its large home market and its special stabilisation funds established in 2006 from the monopolistic revenues of gas and oil export in Europe could support itself during the recessions and mobilise its reserves to support production and services in the aftermath of crises. This could bring down the share of variance of GAP associated with BAA-AAA shocks instead of increasing the variance of GAP associated with endogenous shocks. In particular there was a significant increase in the share of variance of GAP associated with interest rate spread shock as a proxy for banking sector efficiency and competitiveness.

Table 1.5: Generalised variance decompositions of "Cyclical component of output" in the aftermath of crises

Country	Months	Model B (VAR) 2007:M9- 2009:M9					
		Percentage of variance associated with historical shocks from:				Δ, BAA-AAA*, %	Δ, LR **, %
		GAP	LR	DS	BAA-AAA		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Poland	1	74.99	5.57	19.42	0.00	0.00	5.54
	6	21.43	24.82	9.55	44.18	32.22	19.42
	20	16.33	30.00	10.40	43.25	28.78	24.30
Czech Republic	1	84.75	0.73	14.40	0.00	0.00	0.67
	6	53.51	2.77	20.02	23.69	17.24	2.28
	20	48.13	3.19	18.85	29.81	21.32	1.23
Slovakia	1	80.58	19.11	0.29	0.00	0.00	18.75
	6	17.44	20.05	27.75	34.75	33.75	19.61
	20	11.93	14.10	26.07	47.89	36.75	8.66
Hungary	1	78.00	5.81	16.18	0.00	0.00	4.34
	6	66.82	4.86	18.10	10.20	2.62	-6.63
	20	54.94	5.45	12.60	27.69	16.82	-34.00
Lithuania	1	43.41	53.93	2.66	0.00	0.00	52.98
	6	18.46	48.90	22.26	10.36	6.07	47.16
	20	11.53	79.19	7.43	1.84	-3.22	74.23
Latvia	1	80.29	0.00	19.70	0.00	0.00	-1.74
	6	57.23	2.68	7.28	32.79	1.84	-9.57
	20	55.15	3.14	5.58	36.11	9.34	-21.44
Estonia	1	59.14	0.92	39.93	0.00	0.00	-0.5
	6	51.51	3.71	40.29	4.47	-1.27	0.33
	20	32.78	15.53	35.14	16.53	9.35	11.81
Slovenia	1	34.72	12.24	53.03	0.00	0.00	6.71
	6	8.96	54.98	30.70	5.34	-11.78	26.01
	20	8.77	55.00	30.64	5.57	-15.79	29.82
Romania	1	97.11	2.72	0.15	0.00	0.00	1.69
	6	74.63	10.43	12.83	2.10	-37.48	7.00
	20	65.98	16.51	12.54	4.96	-38.61	6.56
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bulgaria	1	81.68	6.33	11.98	0.00	0.00	3.83
	6	46.99	17.46	30.92	4.61	4.03	8.07
	20	36.44	25.71	32.56	5.26	-4.66	15.68
Croatia	1	32.49	32.88	34.62	0.00	0.00	28.83
	6	11.82	54.94	25.95	7.28	5.65	49.58
	20	4.35	76.72	11.39	7.52	5.60	71.02
Russia	1	45.69	4.07	50.22	0.00	0.00	0.36
	6	27.11	7.66	60.69	4.52	-11.59	5.22
	20	26.97	8.12	60.39	4.50	-15.27	4.02
Ukraine	1	98.56	1.38	0.05	0.00	0.00	-0.08
	6	45.84	35.88	9.56	8.70	1.15	31.54
	20	42.50	39.98	8.78	8.71	0.43	26.67

Notes: These decompositions are based on the same assumptions as Table 1.4. However, variance decompositions in the Model IVAR 2007-2009 are obtained for the period of financial crises from September 2007 to September 2009. Standard -error in each series are based on 1000 Monte Carlo repetitions. The models are estimated with two lags instead of 4 lags in Table 1.4 using monthly data from 2001:M1 through 2009:M9 for the period of time from 2007:M9 through 2009:M9 respectively. *Column (7) is calculated as the difference in the share of variance of GAP associated to a shock to BAA-AAA in the Model B (IVAR) for 2001-2007 (Table 1.4) and column (6) in Table 1.5. **Column (8) is calculated as the difference in the share of variance of GAP associated to a shock to LR in the Model B (IVAR) for 2001-2007 (Table 1.4) and column (4) in Table 1.5. Source: Author's calculations.

Now let's move to the analysis of endogenous shocks. Interestingly, Table 1.5 shows an increase in the share of the variance of GAP associated with LR shocks in the aftermath of crises for eleven of the thirteen countries analysed. This is what we could expect from definition 1. In the aftermath of crises the external cost of credit, r_i^* increases as a result of a liquidity crunch and other country shocks generated endogenously. This increased a risk premium that could raise the price of money and therefore have a greater affect on the demand for inputs and economic activity than say in equilibrium.

The fall in the share of the variance of GAP associated with LR shocks for Hungary and Latvia signifies a secondary role of endogenous shocks compared to shocks originated from international financial markets during crises. These countries have suffered most amongst the New EU member states during the Global financial crises appealing to IMF and other financial institutions. It's still disputable whether any financial tightening was applied in these countries as the real lending rate during the crises was very low and sometimes negative. At the same time we can clearly observe an increased share of variance of GAP associated with BAA-AAA shocks and GAP shocks itself for Hungary and Latvia in the aftermath of shock.

Therefore, the channels of exogenous and endogenous shocks to GAP within the period of 2007-2009 were different across the countries. This could be explained by heterogeneous structure of Eastern and Central European economies being analysed, as well their reliance on internal or external financial resources and the activity of multinationals.

It remains true that during the fourth part of 2007 and first half of 2008 (that is, in the immediate aftermath of the financial crisis), exogenous shocks rather than endogenous shocks had important impacts on business activity for such countries as Poland, Czech Republic, Slovakia, Hungary, Latvia and Estonia. Transition countries are successfully integrating into the EU and reforming its legal institutions. Those countries, where the institutional reforms have been weak experienced a higher share of variance of the GAP associated with a shock from LR. The results contrast between the models described in Table 1.4 and Table 1.5, particularly in a dramatic decrease in the share of variance of GAP associated with its own shocks in the aftermath of crises when the business activity seems to be more affected by financial and credit risks.

1.7. Conclusion

Due to a rather new methodology and relatively unresearched area of applications, findings of this paper are twofold: methodological and empirical. On the methodological side, it is possible to formulate effective algorithms for solving large models with cross-section augmentations, generating results which might add more to the knowledge of the modelled systems and markets than the traditional vector autoregressive algorithms. The paper shows that, for multi-country modelling, the links through the real lending rates, intermediation spread, US corporate bond yield spread and output gap are feasible and lead to interesting empirical results. In this context, the Chudik and Pesaran (2007, 2009 and 2010) cross-country augmentations seem to behave well even if the principal limit assumptions (large cross-country dimension and lack of dominance) are violated. The cointegration relationships was not modelled here, as for the newly established countries like Croatia, Latvia, Lithuania, Estonia, Ukraine and other, or substantially transformed Russia, the long-run relationships have time to develop (Charamza et al. 2009).

Regarding the empirical findings of the impact of external and domestic shocks on output fluctuations in transition economies of Central Eastern Europe and Russia, output sustainability to exogenous and endogenous shocks was estimated and the length of the period was identified when a country's economic activity is more likely affected.

Variance decompositions and impulse responses corrected for cross-country interdependence demonstrated that output gap associated both with BAA-AAA and LR shocks is growing faster in short horizons, which signifies an immediate impact of a shock to business activity in the economies analysed. Furthermore, the impact of external shock as an indicator of external investor's risk-aversion in the aftermath of crises was clearly higher in 2007-2009 compared to 2001-2009 for the

majority of the countries. The exceptions are Slovenia, Romania and Russia. This could be explained by the existence of internal financial reserves and large domestic market for borrowing and lending for Russia and deeper integration into EU markets with following up foreign direct investment in Slovenia and Romania.

It's worth noting that exogenous shocks associated with a decrease of a risk appetite to a greater extent than the endogenous shocks were a threat to economic sustainability causing the reduction in GAP in a short run for such countries as Czech Republic, Hungary, Latvia, Lithuania, Russia and Slovenia; in a long run for Estonia, Poland and Slovakia. For Romania and Bulgaria, countries which recently joined the EU the effect of exogenous shock on GAP was positive flagging it's higher integration with the European rather than world financial and credit markets.

There are two trends to be investigated further. At face value the results suggest that on average between September 2007 and October 2009, movements in GAP (its cycle component) for New EU Members were mostly associated with shocks originating from outside the country. For the non-EU countries, where the institutional and market reforms have been weak, and that dependant on output fluctuations in the Russian market, movements in GAP were mostly associated with endogenous shocks. I joined to the voices questioning the effectiveness of financial constraints in countries where financial market and banking sector reforms have been week. These countries appear which is more sensitive to endogenous shocks with higher reliance on internal funds.

Heterogeneity in the effect of domestic shocks on output fluctuations could be also explained by the existing differences in credit channels, dependence on international funding, country's initial conditions, economic structure, degree of market openness, economic competitiveness and resources, political regime and others institutional factors that affect capital mobility.

Finally, the experience of transition economies in the 2000s and in the aftermath of crises provides new challenges, requiring policy-makers to reassess the understanding of the transmission mechanism and the size of exogenous and endogenous shocks from financial markets to real economic activity. Further research might be focused on the policy implications of the results obtained as well as bickering over whether further rescue packages for transition economies proposed by IMF and the European Central Bank (ECB) in recession make sense.

Chapter 2: Entrepreneurship and cities: Evidence from Post-Communist World [11]

2.1 Introduction

Acknowledging the positive relationship between entrepreneurship and economic development, a growing number of empirical studies have focused on explaining variation in entrepreneurial activity at various spatial levels with the majority of them taking either a cross-country perspective or looking at inter-regional differences. More recent studies on entrepreneurship have shifted their focus to examine cross-city variation in entrepreneurship, attributing urban success to more abundant supply of entrepreneurship (Acs et al. 2008; Glaeser 2007; Glaeser et. al 2010; Glaeser and Kerr 2009; Bosma and Schutjens 2007, 2009; Belitski and Korosteleva 2010).

Acs et al. 2008 explore differences in entrepreneurial perceptions and entrepreneurial behaviour across 34 world cities using Global Entrepreneurship Monitor data. While their paper provides a rich comparison of the characteristics of new venture creation across world cities, it falls short of providing testable implications for variation in entrepreneurship across these cities. Bosma and Schutjens (2009) explore the determinants of entrepreneurial activity at a larger level of regional aggregation in Europe. Belitski and Korosteleva (2010) explore how various demographic, socio-economic and institutional characteristics of European cities and country-level settings affect entrepreneurship in 377 European cities during the period of 1989-2010. Despite a growing number of spatial-oriented studies of entrepreneurial activity worldwide, to our best knowledge Belitski and Korosteleva (2010) are the first who attempted to explain variations of entrepreneurship across European cities, distinguishing between Western and East European cities, by this providing some insights on whether cities of transition economies are any different from their Western counterparts in terms of factors driving their entrepreneurial activity.

Estrin and Mickiewicz (2011) show that transition economies generally exhibit lower rates of entrepreneurship than observed in most developed and developing market economies. They argue that this difference is even more pronounced for the Commonwealth of Independent States (CIS) compared to Central and Eastern Europe (CEE). Despite the fact that small businesses have steadily become to play a more important role in urban economics of transition, there is still an obvious scarcity or virtually no existence of research in this field in the context of transition economies. The scarcity of cross-city research in the context of the region can be attributed to a number of reasons: lack of data; prevailing conventions of planning at larger geographic scales such as municipalities and beyond; and an incongruence of approaches for measuring entrepreneurial activity among transition countries.

This paper investigates variation in entrepreneurial activity, proxied by the logarithm of number of small businesses, across 98 cities located in seven CIS countries, namely Russia, Ukraine, Belarus, Moldova, Georgia, Armenia and Azerbaijan, during the period of 1995-2008. We employ an advanced econometric technique, the System Generalised Method of Moments (SYSGMM) technique, to estimate our model. This allows us to address a number of econometric problems, including potential endogeneity of some of our repressors the presence of predetermined variables, and the presence of fixed effects which may be correlated with the regressors.

In the recent years an increasing amount of entrepreneurship research has evolved around the effect of various institutional arrangements, such as cultural, social, and legal structures, which are thought to provide the context and legitimacy for operation of entrepreneurial organization (Busenitz et al. 2000; Ahlstrom and Bruton, 2002; Bruton et al. 2010; Manolova et al. 2008; Smallbone and Welter, 2006). With the collapse of communism, which was characterised by the suppression of private initiative, transition economies have undergone a colossal change involving comprehensive institutional reforms as they moved towards a market economy. For this reason, the institutional

[11] This essay is the result of collaboration with Dr. Julia Korosteleva from SSEES, UCL (UK) and is the final draft of our joint paper Belitski, M. and Korosteleva, J. (2011) Entrepreneurship and cities: Evidence from post-communist world, WIFO Working Papers, 2011. I attempted to introduce my own contribution.

environment is seen to have a more dominant influence in determining the pace and type of entrepreneurship in this region (Manolova et al. 2008; Estrin and Mickiewicz, 2010). This motivates us to more closely examine how the institutional environment shapes entrepreneurship in CIS cities.

To investigate variation of entrepreneurship across CIS cities we utilize a four-pillar institutional framework building upon Scott's (1995) and Stenholm's et al (2010) research which emphasizes the role of four institutional dimensions, namely regulative, normative, cognitive and conducive, on entrepreneurial developments across CIS cities. We extend this framework by developing a theory on the crucial role of higher education institutions in accelerating entrepreneurship developments in the CIS region.

Institutions operate at different levels of aggregation starting from the world system through supranational governance structures, country-level arrangements, regional frameworks to localised interpersonal relationships (Scott 1995). While studying cross-city and cross-country differences in entrepreneurship it is important to account for this multilevel dimension of institutions, as the effects of institutional arrangements may vary depending on the level of regional aggregation. Some institutions are more harmonized and more integrated at a country level than others. For example, property rights protection or business entry regulation as mandated by law, are expected to have a more differential effect at a country level, whereas differences in higher education as an institution and the way it shapes entrepreneurial activity may be more pronounced at a city level. In former Soviet Union countries, mega-cities are likely to host a diverse number of both classic and specialised institutions[12], while smaller cities are more likely to host institutions specialising only in a specific field of science. The intensity and quality of research in higher education institutions and the degree of their collaboration with industry may also differ across cities, which, in turn, through knowledge spillovers, is likely to influence the level and types of entrepreneurial activity and city economic performance. Expecting a differential effect of institutions on entrepreneurship depending on the level of contextual aggregation at which they operate, we look at the effects of institutional arrangements on entrepreneurship in CIS cities at both city and country levels.

While we find that some domains of the regulatory environment, namely a well-functioning banking sector and the size of state activities, matter in explaining heterogeneity in entrepreneurial activity across CIS cities, our key finding is related to the role of higher education establishments assumed to facilitate entrepreneurship in the region. Formally placed within the regulative environment and mandated by national laws on education, higher education as an institution has become increasingly sustained by other pillars that, taken jointly, accelerates entrepreneurial entry in the region.

The paper proceeds as follows. The next section discusses issues pertaining to entrepreneurship in the transition context, outlines the theoretical framework, and formulates hypotheses. The two subsequent sections discuss data and methodology and empirical results, whereas the last section highlights policy implications of our research.

2.2. Theoretical concepts, hypothesis and controls

2.2.1. Entrepreneurship in the context of transition

Since the definitive work by Douglass North (1990) an increasing amount of entrepreneurial research literature has focused on examining how the institutional context shapes entrepreneurship and defines its success (Bruton et. al. 2010; Estrin et al., 2011). The institutional environment provides a basis for legitimacy for business operation, making it acceptable and desirable by the society (Suchman, 1995). The institutional theory has proven particularly useful in examining the

[12] By classic universities we mean higher education institutions offering degrees across different scientific fields –from mathematical sciences to history, whereas by specialised institutions we mean those which offer a degree in a specific scientific field such as economics, computer science, or architecture.

differences in the rate and type of entrepreneurial activity in transition countries (Aidis et al., 2008; Manolova, et al. 2008; Estrin and Mickiewicz, 2010).

Numerous studies show that entrepreneurship levels in the transition economies are lower compared to other developed and developing economies, which is even more the case for the CIS compared to Central and Eastern Europe (McMillan and Woodruff, 2002; Estrin, Meyer and Bytchkova, 2006; Aidis et al., 2008). Estrin and Mickiewicz (2011) attribute this to the negative effect of the legacy of communist planning, which needs to be replaced with formal market-supporting institutions. Not earlier than a decade after transition began the policy-makers have started anticipating that the transition from communism goes beyond privatisation, liberalization, and decentralisation; it requires a creation of the institutional infrastructure, including legal and regulatory frameworks (Stiglitz, 2002). Implementing institutional reforms aimed at establishing market-oriented institutions in these countries. With the longer prevalence of the communist rule in Former Soviet Union countries the erosion of institutional memory in this region has taken them longer than their counterparts in Central and Eastern Europe to build up a well-functioning institutional framework conducive to entrepreneurship development (Estrin and Mickiewicz, 2011).

As EBRD (2010) transition indicators show there is still little progress in reforming some particular institutional domains in CIS countries, in particular in part of establishing institution of private property with private sector contributing from as low as 25 (per cent) to GDP in Turkmenistan, followed by Belarus (30 per cent) and Uzbekistan (45 per cent). Generally speaking, after two decades of transition the business environment in some CIS economies still remains unfriendly for entrepreneurship development, creating a void typically filled by informal institutions (Puffer et al. 2009).

With a slow pace CIS economies have progressed in various aspects of institutional reforms. However, establishing a well-functioning set of new formal institutions takes longer given that informal institutions, comprised of values and norms, are more durable and slowest to change (North, 1990; Williamson, 2000; Estrin and Mickiewicz, 2011). As Estrin and Mickieiwcz (2011) argue, the legacy of communism was not conducive to entrepreneurship, "as reflected not just in the remnants of the command economy" (typically seen in Belarus[13]), "but more importantly by the social attitudes shaped during the communist period" (see also Estrin et al., 2006; Schwartz and Bardi, 1997). By viewing generalised trust as an important prerequisite to entrepreneurship[14], Estrin and Mickiewicz (2011) argue that it was particularly negatively influenced by the prevalence of a system of norms and values associated with communism. The conditions of surveillance and detailed monitoring of citizens in soviet times triggered distrust that was often in contradiction to the official ideology promoting cooperation and trust (ibid.). The authors conclude that given slow pace of change in informal institutions rebuilding generalized trust may be delayed until after full generational change.

2.2.2. Institutional theory

The concept of institutions is multifaceted, and it embraces different topics across a wide range of social science fields ranging from economics and political science to sociology (Scott, 1995; Bruton et. al., 2010). Economists have studied organizations as institutional forms and economic processes, focusing on the incentives underlying the complexity of institutional environment, while employing theories based on assumptions of bounded or perfect rationality. More specifically, one branch of the institutional economic thought focuses on transaction cost theory and property rights (Scott, 1995). Williamson (1975, 1985) looks at how establishing organizations as the complexity of 'governance structures' helps reduce transaction costs, extending this view further to account for the background conditions such as norms, property rights and rule of law underlying the choice of

[13] See Korosteleva and Lawson (2010) for further discussion of this.

[14] Estrin and Mickiewicz (2011) argue that trust is an underlying element of cooperation which defines many aspects of entrepreneurship, including reliance on networks of contacts in start-up stage; in relation to entrepreneurial finance or establishment of relationship with suppliers in terms of, for example, securing trade credit from them.

alternative governance structures. Accordingly, Williamson (2000) proposes that institutions can be considered in terms of a hierarchy comprising four levels, each placing constraints on the levels below. He places society's embedded informal institutions (customs, traditions, norms and religion) at the top of the hierarchy regarding them the most permanent and the slowest to change. The next level comprises formal rules underlying property rights protection. The third level is governance of contractual relations which affects interactions of economic agents aligning governance structure with transactions, and ultimately affecting resource allocation comprising the forth level.

Williamson's hierarchical approach echoes Douglass North's (1990) work on institutions examining how the complexity of cultural, political and legal frameworks influence economic development. According to North (1990) institutional arrangements define incentives which guide individual and organizational rational choices. He distinguishes between formal "rules of the game" comprising laws and regulations, and informal or unwritten codes comprising social arrangements, and shows how via interaction these institutions either constrain or empower social behavior.

Unlike economists who view institutions as resting primarily on formal rules, sociologists, largely building upon the cognitive and cultural theories, emphasize that variation in formal institutions is deeply rooted in social and cultural context, which influences the social desirability of organizational activity (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Granovetter, 1985; Zucker, 1991; Scott 1995; Busenitz, Gomez and Spencer, 2000). Zucker (1991) embraces institutions from the micro environmental perspective, stressing the importance of cognitive beliefs and institutionalized social knowledge in shaping organizations. Meyer and Rowan (1977) see institutions not only as complexities of technical sophistication or relational patterns, but also of cultural rules supportive of organizations. DiMaggio and Powell (1983) identify three important transmission mechanisms by which institutional effects are disseminated through a field of organizations. Along with a coercive channel associated with enforcement of formal rules, they distinguish mimetic and normative channels emphasizing the importance of social micro-level structures in determining economic agents' behavior in an economy.

Following this line of argument, entrepreneurs, like any other individuals and organizations, will be influenced by the institutional context in which they operate and their strategies will respectively reflect the opportunities and limitations defined by this context (Baumol 1990, 1993; Baumol et al., 2007; Busenitz, Gomez and Spencer, 2000; Sobel, 2008; Boettke and Coyne, 2009; Aidis et al., 2008; Aidis et al., 2010; Bruton et al., 2010; Estrinet al., 2011). Baumol (1990, 1993) argues that institutional arrangements which define a prevailing system of payoffs will influence allocation of individual efforts between different types of entrepreneurial activity whether this is productive, unproductive or destructive. A set of framework conditions based on excessive regulation of business activities, high level of corruption and poor protection of property rights may produce undesired economic outcomes stimulating the development of shadow economy, or leading to misallocation of resources and capturing transfer of existing wealth that in Baumol's terminology is defined as unproductive entrepreneurship (Sobel 2008). To facilitate economic growth policy-makers are urged to develop institutions which will increase relative reward for individuals to engage in the creation of wealth through realizing innovative growth-oriented projects seen as an important element of productive entrepreneurship (Baumol 1990, 1993; Sobel 2008).

Empirically, a well-developed business environment characterized by strong property rights protection, efficient system of contract enforcement and independent judicial system, and limited government's ability to transfer wealth through taxation and regulation, is shown to incentivize individuals to launch productive market businesses and more so high-growth innovative ventures with the potential to generate high economic returns (Bowen and De Clercq, 2008; Sobel 2008; Acs 2010; Autio and Acs, 2010; Estrin et al., 2011; Stenholm et al., 2010).

Our investigation of how the institutional context influences entrepreneurship across cities in the Commonwealth of Independent States builds upon the theoretical framework proposed by Scott (1995) and extended by Stenholm, Acs and Wuebker (2010) which develops an integrated model of institutions drawing on the above perspectives.

2.2.3. The four-pillar institutional framework

More specifically, Scott (1995) proposes the following three crucial elements of institutions: (1) "regulative" framework comprising regulations, laws and sanctions which are legally binding; (2) "normative" context underpinning social values, norms and beliefs which are morally governed and culturally supported; and (3) "cognitive" pillar constituting the "shared logics of action" among individuals and organizations which they use in interpreting available information and formulating their expectations and response strategies. Stenholm, Acs and Wuebker (2010) extends Scott's three-pillar model to include the "conducive" dimension - a "fourth institutional pillar" – which captures the conditions that primarily affect the quality of entrepreneurial activity and forms the grounds for generation and dissemination of innovative ideas and technologies, stimulating the rate of high-impact entrepreneurship, regarded as an essential part of Baumol's productive entrepreneurship (Ireland, Hitt and Sirmon, 2003; Agarwal et al., 2007; Audrestch and Keilbach, 2007; Stenholm, Acs and Wuebker, 2010). Below we discuss the literature underpinning the theoretical arguments related to each of the four institutional pillars and formulate our hypotheses based on this discussion.

Regulative pillar

The regulative dimension largely originates from the institutional economics theory which emphasized the importance of formally codified and enforced rules of law. Formal regulative structures may simultaneously enhance entrepreneurial activity and constrain it. As discussed earlier, the former occurs via better functioning legal and regulatory institutions reducing transaction costs such as, for example, linked to contract enforcement, and via reducing risk associated, for example, with expropriation of private assets either by the state or economic agents. Better functioning formal institutions consequently enable the economy to move from a 'relationship-based personalized transaction structure to a rule-based, impersonal exchange regime' (Peng, 2003). In our study we examine the effect of the following formal institutional dimensions: (1) the development of financial institutions captured through the progress in banking reform[15]; (2) property rights protection; (3) size of the government associated with its ability to transfer wealth via taxation and corruptive practices; and (4) business regulation.

Banking sector reform

It is widely acknowledged that more developed financial markets are likely to alleviate borrowing constraints through the wider allocation of savings to potential investment projects and facilitation of the risk management in the presence of information asymmetries and transaction frictions (Levine, 1997). Better developed financial institutions, to the extent of mitigating external finance constraints, are found to disproportionally benefit more small and medium-sized firms (Beck et al., 2005). With wider supply of finance and competition, the financial institutions are pushed to choose more risky financial options including entrepreneurial finance (Korosteleva and Mickiewicz, 2011)[16]. This is particular topical for transition economies for which scarcity of financial resources is documented as one of the major obstacles for starting-up a new venture (Pissarides, 1998, 1999, 2001; Pissarides et al., 2003; Klapper et al., 2002; Korosteleva et al, 2011). Pissarides (2001) shows that lack of access to finance is more binding for SMEs than larger businesses. Financial constraints were found to have not only detrimental to entrepreneurial entry, but also for SMEs' growth and their potential to innovate and export (Klapper et al., 2002; Pissarides et al., 2003; Gorodnichenko and Schnitzer, 2010). Pissarides et al. (2003) also show that financial constraints affect SMEs more than barriers related to property rights issues.

[15] As part of structural reforms viewed as institutional outcome measures (Glaeser 2004) along with progress in banking reform we also tested the significance of competition policy; enterprise restructuring and privatization, securities market establishment, utilizing EBRD transition indicators, but we failed to obtain any significant results. These results available from the authors upon request.

[16] Bank managers typically regard entrepreneurial ventures as highly risky given a higher asymmetry in information, lack of accounting records and credible reputation, associated with entrepreneurial projects (Huyghebaert and Van de Gucht 2007; Korosteleva and Mickieiwciz, 2011; Korosteleva *et al.* 2011). They also find it costly to monitor small businesses given their small scale, although with the advances in the risk scoring techniques the banking sector is capable to handle the entrepreneurial finance better than in the past (De la Torre *et al.* 2008).

The banking sector reform aimed to advance the financial development through the establishment of a two-tier banking system, liberalisation of interest rates and credit allocation, full convergence of banking laws and regulations with Bank of International Settlements standards, and provision of full set of competitive banking services (EBRD, 2010). The progress in reforming the banking sector was slow. Overall, after more than two decades of the financial sector reform the majority of CIS countries still have rather shallow domestic credit systems with domestic credit to private sector as a proportional of GDP ranging from as low as 18 per cent in Azerbaijan to as high as 45 per cent in Russia[17].

Using the EBRD 2002-2009 Business Enterprise Environment and Performance Survey data Korosteleva et al. 2011 show that given external finance constraints SMEs in transition economies tend to largely rely on their internal funds or retained profits in funding their fixed assets investment (80 per cent of SMEs). Only about 23 per cent of small and medium-sized firms rely on borrowing from private banks. Based on the above discussion we expect that a more developed banking sector will increase credit availability to SMEs, mitigating external finance constraints as an obstacle for starting-up new ventures. Respectively, our first hypothesis postulates:

Hypothesis 1: Progress in banking reform is positively associated with entrepreneurial entry.

Property rights protection

Strong property rights are important for any form of entrepreneurship to the extent that in the first place property rights guarantee the status quo via providing crucial security of private property against an arbitrary action of the executive branch of the government (Acemoglu and Johnson, 2005; Estrin et. al., 2011). It has been shown that strong property rights have a fundamental positive effect on economic activity and entrepreneurship. Acemoglu and Johnson (2005) find that property rights institutions significantly influence investment, financial development and long-run economic growth. In the environment with weak enforcement of property rights, financial contracts are less likely to be concluded forcing banks to ration credit with small firms to be disproportionally affected the most preventing their entry (ibid.). Aidis's et al. study (2010) reveals that among various institutional measures strong property rights protection plays the most important role in explaining entrepreneurial entry. Estrin et al. (2011) show that a weak property rights also emerge as significant constrain for entrepreneurs' growth aspirations thus imposing some limitations on an economy's growth potential.

Estrin et. al. (2011) also look at a narrower dimension of property rights, namely intellectual property protection which is expected to affect high-growth businesses, assuming that those are driven by a product or process innovation and hence particularly exposed to imitation of their ideas. However, they fail to find any significant effect of intellectual property protection on entrepreneurs' growth aspirations. Interestingly, studying 177 of the most significant shifts in patent policy in 60 countries over 150 years Lerner (2009) finds that intellectual property protection is negatively associated with innovation output. This may be attributed to the increased rigidity of intellectual property rights restraining entrepreneurship instead of promoting it (Baumol and Strom, 2007). These more recent findings de-emphasize the effect of intellectual property rights on entrepreneurship (Estrin et al., 2011). In our study we explore the effect of the constitutional dimension of property rights given that our sample is comprised not only of innovative entrepreneurial activities, but of all its types. Based on this we postulate our next hypothesis.

Hypothesis 2: Strong property rights protection is likely to incentify entrepreneurial entry

Size of the state

[17] Source: World Bank (2011): World Development Indicators (edition: September 2011). ESDS International, University of Manchester. DOI: http://dx.doi.org/10.5257/wb/wdi/2011-09. Tajikistan and Uzbekistan are excluded from this comparison given data unavailability.

The size of the state has been argued to adversely influence entrepreneurial entry (Aidis et al., 2010) and entrepreneurs' employment aspirations (Estrin et. al., 2011). Higher tax income associated with a larger size of the state and higher marginal tax rates for higher earners reduces the expected returns to entrepreneurs and discourages entrepreneurship (Parker, 2009). At the same time higher tax income can also be associated with a more generous welfare provision system, implying among other things higher unemployment benefits, that is expected to increase opportunity cost of going into entrepreneurship.

Larger state may also reflect government's higher ability to transfer wealth through a differential tax policy applied by regional authorities, and other corruptive practices (Aidis et al., 2010; Aidis et. al., 2009). For example, in Russia a large number of SMEs pay taxes in accordance to a single tax on businesses' imputed income, introduced in 1998. Prior to tax reform in 2003, regional authorities were given discretion to set a base yield for various types of business activities which are subject to a single tax that effectively gave them considerable power over the calculation of the single tax "providing ample opportunities for corrupt behaviour to flourish" (Aidis et al., 2009: 266). While a new tax policy, introduced on 1 January 2003 and revised further in 2006 centralised the setting of a base yield, municipal authorities have gained some discretionary power to regulate a coefficient which is used to correct a base yield, taking into consideration some particularities of businesses such as the range of goods sold, seasonality of operations and location. A corrective coefficient is used for adjusting the value of base yield to account for the differences in business conditions. While the declared objective was good-natured aiming to reduce the tax burden for businesses facing the least favourable conditions, in reality, this approach has allowed municipal authorities to pursue a differential policy towards SMEs favouring well-connected business owners (ibid). As demonstrated by OPORA's 2006 survey data[18], half of the 61 per cent of the interviewed entrepreneurs who were subject to a single tax said that the overall tax burden had increased with the municipalities having obtained some discretionary power over a single tax (ibid.). Similarly, Zhuplev et al. (1998) discusses that one of the main obstacles Russian entrepreneurs face is government corruptive practices, "the vagueness of the functions of state bureaucrats and the demands they impose on entrepreneurs and the lack of uniform interpretation of the laws" regulating entrepreneurship that sets provisions for rent-extracting by the state.
Accordingly we hypothesize:

Hypothesis 3: A greater size of the government will discourage entrepreneurial entry.

Business regulations

According to the public interest theory of regulation, a stricter businessregulation, requiring a proper screening of new firms will allow for the entry of only those firms which meet minimum standards for providing a quality product or service that should benefit the society. On the other hand, the public choice theory views regulation as benign and socially inefficient. One strand of this theory (see Stigler, 1971) argues that regulation is acquired by the industry, and industry incumbents are likely to benefit the most. Once they are able to influence the regulation in their favour, incumbents increase their power to the extent that restraints entry of new firms and competition. Another strand of the public choice theory advocates that regulation is pursued for the benefit of politicians and bureaucrats who use it to create rents and to extract them via corruptive practices (De Soto, 1990; Shleifer and Vishny, 1998).

In their study of the regulation of entry of start-ups in 85 countries Djankov et al. (2002) find that countries with overly regulated business environment have higher level of corruption and larger unofficial economies, providing some supporting evidence for the public choice theory argument. In their majority, empirical studies on business regulation conform to the proposition that over-regulated environment inhibits entrepreneurial entry (Grilo and Thurik, 2005; van Stel et al., 2007).

[18] OPORA is Russia's NGO representing small and medium-sized enterprises.

Regulatory constraints are found to be of particular detriment to opportunity-driven entrepreneurship (Ardagna and Lusardi, 2008). Vice versa, lower entry barriers are positively associated with the rate of firm entry (Klapper et al., 2006; Demirguc-Kunt et al., 2006). Respectively, our next hypothesis is formulated as follows:

Hypothesis 4: More flexible business regulations encourage entrepreneurship

Finally, within the regulative institutional domain there is also need to discuss higher education institutions which are formally constructed within the regulative environment given that their establishment and operation are mandated by national laws on education. Higher education institutions help facilitate the rate of human capital formation seen as one of the factors influencing entrepreneurial activity across countries and regions (Davidson and Honig, 2003; see also Parker, 2009 for overview of this literature). Barberis et al. (1996) provide some evidence for the important role of human capital for successful new entry by small firms in Russia. Given that higher education institutions constitute a central focus of our analysis and are sustained by other institutional pillars considered below we will elaborate more on their role in fostering entrepreneurship in the subsequent paragraphs.

Normative pillar

The normative institutions influence social behavior through a system of values, beliefs and norms. They are typically viewed as the standards of behavior established, for example, by close social networks (family and friends), professional associations and business groups, which underlie organizational goals and objectives (Scott, 1995; Manolova et al., 2008; Bruton et al., 2010). Values and beliefs of social groups influence entrepreneurial intentions to the extent of communicating a message to individual entrepreneurs of the relative desirability of their activity (Krueger et al., 2000). Such beliefs may be embedded in a wider setting of social references underpinned by national culture (Stenholm, Acs and Wuebker, 2010).

In the former Soviet Union until 1988 any kind of private business activity was regarded as illegal, and the society had a hostile attitude to entrepreneurs regarding them as speculators and associating small business with theft from the community rather than the creation of wealth and prosperity (McCarthy et al., 1993; Smallbone and Welter, 2001). This soviet legacy, embedded in the socio-cultural setting of CIS countries, negatively affected entrepreneurial orientations at the start of transition. It is argued that among other things a country can cultivate a positive image of entrepreneurship through the educational system (Verheul et al. 2002). The whole academic tradition of the Soviet-style higher education was rigidly teacher-controlled, exam-driven and hierarchical, allowing little personal contact and limited opportunities for active learning. Lecturers primarily relied on rote learning principle based on memorisation of concepts and they discouraged critical thinking. 'Teaching students how to think' was lacking in the Soviet tradition of higher education. The past two decades have seen some profound changes in the higher education system across the region. Neoclassical economics advocating free markets and a system of values associated with them (e.g. individualistic orientation, earning on merit, different thinking, risk tolerance), marketing, management and entrepreneurship modules have become increasingly integrated in the higher education curriculums. Furthermore, the whole teaching-learning approach has undergone a significant change with rote learning principles being replaced with critical thinking stimulating innovative ideas and creativity, and individualistic approach.

It has been argued that cultural values, including the degree to which people prefer to work as individuals rather than in groups, willing to accept inequality, tolerate risk and favor virtues of assertiveness, competition and success, influence entrepreneurial orientation[19] (Kreiser et al., 2010).

[19] These values broadly reflect Hofstede's (1980) four cultural dimensions, namely individualism, power distance, uncertainty avoidance, masculinity.

More individualistically-oriented cultures with positive perception of uncertainty and risk taking are shown to have a higher entrepreneurship orientation and higher appreciation of entrepreneurship (Bowen and De Clercq, 2008; Kreiser et al., 2010). Incorporating these insights into our discussion of higher education institutions we conclude that a rapidly changing educational system in CIS countries assumes an important role of cultivating positive social attitudes towards entrepreneurial activities through teaching entrepreneurship-related modules and communicating the benefits of entrepreneurship as an alternative occupational choice to students, and in general through a new teaching-learning approach which underlies a change in a system of values more conducive to entrepreneurship. Altogether this makes entrepreneurial activity more socially desirable.

Cognitive pillar

The cognitive environment represents a common set of references, schemas and scripts specific to a socio-cultural context, and typically learned and adopted through social interactions (Scott, 1995; Bruton et al., 2010; Stenholm et al., 2011). Busenitz et al. (2000: 995) define the cognitive dimension as comprised of "the knowledge and skills possessed by the people in a country pertaining to establishing and operating a new business". They continue to argue that within some countries this knowledge becomes institutionalized and being shared widely across individuals. Individuals' perceptions of knowledge and skills to start a new business are shown to direct abilities of entrepreneurs to identify new opportunities and exploit them (Shane, 2000; Baron, 2007).
One of Busenitz's et al. (2000) findings suggests that perceived knowledge about starting new businesses may be particularly prevalent among individuals with higher education attainment. Education may affect individuals through providing them with a sense of autonomy and the skills which are necessary for discovering entrepreneurial opportunities (Verheul et al., 2002). Educational capital does not only explain entrepreneurial entry but also type of entrepreneurial activity, being found to positively affect high-growth expectations among entrepreneurs (Bowen and De Clercq, 2008). They argue that it is also important to distinguish between 'general education' and 'specific education' promoting specific entrepreneurial skills, suggesting that it is the extent of education capital targeted specifically at entrepreneurship is what determines the allocation of entrepreneurial effort within a country.

Smallbone and Welter (2006) argued that entrepreneurs in post-communist economies have higher educational attainment but they lack entrepreneurial knowledge and skills given the soviet legacy of suppressed private initiative (see also Zhuplev et al., 1998). A large number of highly-educated entrepreneurs were struggling to match knowledge and skills acquired through higher education with market opportunities, often starting up low-skilled and low-value adding businesses such as retail trade or low-tech services[20]. With an educational institutional reform there is an increasing scope for integrating entrepreneurship-related modules in nationwide education curriculums that makes higher educated individuals acquire not only general knowledge and skills but also marketing and business management skills that is expected to enhance their entrepreneurial orientation. Drawing on these insights we argue that the educational system influences entrepreneurial entry and different types of entrepreneurial activities by affecting individuals' perceived knowledge and skills they need to start-up a new venture.

Conducive pillar

The conducive environment, proposed by Stenholm et al. (2010) to solve the puzzle of how the three institutional pillars shape entrepreneurial behavior to direct their efforts to productive ends, is comprised of conditions which underlie the environment filled with new opportunities created by knowledge spillovers (Audretsch and Keilbach, 2007). To give some examples, such conditions

[20] To illustrate this Welter and Smallbone (2010:111) discuss a case study the owner of a successful business involved in managing and letting advertising hoarding space in Minsk, Belarus, who was considering opening a coffee shop rather than expanding her key business. She explained this referring to business expansion strategy of 'being too risky because her successful enterprise was beginning to attract too much attention of the wrong sort".

include availability of high-skilled labour, proximity to high-quality universities, development of entrepreneurial clusters, intensity of collaboration of higher education institutions and industry which all facilitate the formation of high-impact entrepreneurs, engaged in the pursuit of innovations and oriented towards growth and early internationalization of their operations (Stenholm et al., 2010). In other words, this pillar determines the institutional capability by a country, region or city to develop "strategic entrepreneurship" defined as activities based on the search of competitive advantage which through generation of new products, processes, markets, and organizational forms can lead to wealth creation sustainable in a long run (Hitt et al., 2001; Ireland et al., 2003; Agarwal et al., 2007; Agarwal et al., 2010). Knowledge spillovers are seen as a central element to strategic entrepreneurship (Agarwal et. al., 2010). The knowledge-based theory views knowledge as one of the most strategically important resources of a firm, determining its comparative advantage, (see Grant, 1996). Knowledge also emerges as a driving force behind regional and macroeconomic growth (Saxenian, 1994; Romer, 1990; Aginion and Howitt, 1992). However, possessing knowledge is not sufficient for generation of innovative output. Agarwal, Audretsch and Sarkar (2007) develop a model of "creative construction" which shows how knowledge spillovers combined with an entrepreneurial action, enabling knowledge appropriation, leads to new firm creation and explains the success of industries and regions and the growth of economy as a whole. Focusing on localized knowledge spillovers Gambardella and Giarratana (2010: 323) show how their intensity increases the supply of knowledge to benefit more individuals who have better education and greater skill or in other words individuals with the highest "absorptive capacity to use this knowledge". This increases the productivity gap across skills and increases regional heterogeneity in terms of skill endowments with regions characterized by intense knowledge spillovers being more populated by "skilled-intense organizations that generally are smaller and oriented toward entrepreneurial ventures" (Gambardella and Giarratana, 2010: 324).

Start-ups are inevitably about new ideas, and the ability of some agglomerated locations to foster new ideas is one potential reason why they become centers of entrepreneurship and self-employment. Ideas are often outcomes of 'knowledge intensive environments', i.e. groupings of large and small firms interacting with public research organisation and providers of knowledge intensive services. Spatial concentrations boost entrepreneurship by supporting the transfer of old ideas and the creation of new ones. Saxenian (1994) argues how the flow of ideas helped to create the entrepreneurial cluster of Silicon Valley. In her more recent work she extends her analysis by looking at how mobility of information and highly skilled workers with work experience and connections to Silicon Valley and related American technology centers, termed 'Argonauts' contributed to the success of the economies of Taiwan and Israel turning them from peripheral regions specialized in low-skill labor-intensive manufacturing into centers of technology entrepreneurship (Saxenian, 2007).

Higher education establishments are shown to enable human capital creation; accumulation of knowledge; the formation of regional innovation systems; entrepreneurialism; and regional economic and social development (Arora et. al, 2011; Etzkowitz, 2002; Etzkowitz and Leydesdorff; 1999; Chatterton and Goddard, 2000; Gunasekara, 2004; Holland, 2001). Respectively, cities with higher concentration of higher education establishments are more likely to be incubators of new ideas. As part of Europe's agenda to promote sustainable growth via innovation and entrepreneurship, many EU neighbourhood countries, including the majority of the CIS states studied here; embark on promotion of clusters, enhancing also collaboration between small businesses and research institutions.

2.2.4. Understanding the role of higher education institutions: integrated approach

Drawing on the above insights highlighting the role of higher education institutions on entrepreneurship within the four institutional dimensions, we further adopt an integrated approach in studying its effect on entrepreneurship across CIS cities. Scott (2008:54) argues that "institutions supported by one pillar may as time passes and circumstances change, be sustained by different

pillars". Higher education institutions formally constructed within the regulatory pillar and bound by national laws on education, are embedded in the other three pillars discussed above. Through undergoing an institutional change they emerge to counterbalance the Soviet legacies to the benefit of entrepreneurship development in the region. They may influence entrepreneurial activity through various channels such as (1) human capital formation; (2) shaping a system of societal values and norms which cultivate a positive attitude towards entrepreneurship; (2) affecting individuals' perceptions about knowledge and skills necessary to start up a business; (3) knowledge spillovers. The embeddedness of higher education institutions within all four institutional pillars makes them well placed to accelerate the development of environment conducive to entrepreneurship. Based on this discussion, our last set of hypotheses can be formulated as follows.

H5a: Cities with higher concentration of higher education establishments are likely to have higher entrepreneurial entry.
H5b: The effect of higher education institutions is further reinforced through knowledge spillover effects occurring to the manufacturing industry.
H5c: To the extent that higher education institutions are embedded into all four institutional pillars, the effect of education is expected to be one of the dominant institutional effects affecting entrepreneurship in CIS cities.

2.2.5. Other controls

At the macro level entrepreneurship literature suggests that entrepreneurial activity varies in countries at different stages of their economic development (Wennekers et al., 2005). We introduce city-level GDP pc to control for stage of the development. According to a typology used by the World Economic Forum, countries worldwide can be broadly divided into "factor-driven," "efficiency-driven" or "innovation-driven" economies by the stage of their economic development. The 2010 Global Entrepreneurship Monitor report (2009) shows that efficiency-driven economies, comprising Russia among others, typically exhibit a lower level of entrepreneurial activity reflecting the emergence of economies of scale with individuals preferring income stability, while being employed by larger firms, over risky business initiatives (Wennekers et al. 2005).

Along with the level of income we also consider unemployment as part of socio-economic characteristics of cities as a likely determinant of entrepreneurial entry. The effect of the rate of unemployment is ambiguous. On the one hand side, it may have a push effect with entrepreneurship being seen as the only available occupational alternative. In this case entrepreneurship is most likely to be necessity-driven and associated with basic low-scale business activities (Mandelman and Montes-Rojas, 2009). It is important to note here that necessity-driven entrepreneurship is more likely to take a form of self-employment, implying that the unemployment effect may not necessarily show up or it may be inversely associated with entrepreneurship when proxied by small businesses. Furthermore, higher tax income can also be associated with a more generous welfare provision system, implying among other things higher unemployment benefits, which could reduce incentives to go into entrepreneurship. Furthermore, unemployment is a cyclical phenomenon and may simply mirror economic recession and demand deficiency, making entrepreneurial entry unlikely.

The level of criminality in cities is also likely to affect entrepreneurial entry reflecting higher probability of asset expropriation by private parties. According to Rosenthal and Ross (2010) entrepreneurs will choose the safest location for doing their business. Central to their analysis is the idea that different sectors of the economy will sort into high- and low-crime areas depending on their relative sensitivity to crime. We expect a negative effect of city criminality on entrepreneurial entry.
We also control for capital investment ratio in cities to capture the availability of financial resources in CIS cities. Although, generally expected to have a positive effect on entrepreneurial entry, the role of capital investment in the context of the FSU may be ambiguous, and the possibility of a crowding out effect as a result of public funds being channelled to support large-scale state-owned enterprises is not excluded.

We introduce the effects of urbanisation economies. Local interactions that give rise to agglomeration spillover for entrepreneurship are extensively discussed in Duranton and Puga (2004) and Rosenthal and Strange (2004). The proposition that agglomeration economies have a positive effect on productivity goes back to Marshall (1920). The scale of the urban environment may impact productivity through availability of a larger pool of workers and their skill diversity, co-location of firms across diverse industries, the proximity of customers and suppliers. In agglomeration economies a larger home market essentially increases the returns to business entry (Agrawal et al., 2008; Gerlach et al., 2009; Simonen and McCann, 2008). So, the incidence of entrepreneurship is likely to be higher in urban agglomerations where entrepreneurs' payoffs are governed by higher technology, knowledge and consumer demand. Respectively urbanisation economies are expected to have a positive impact on entrepreneurial entry. Finally, we control for the size of the market, proxied by the natural logarithm of population density, industry composition, and country and time effects.

2.3. Data and methodology

2.3.1. Sample Description

To investigate variation of entrepreneurship across FSU cities we utilise the 1995-2008 data collected from the Offices of National Statistics in Russia, Ukraine, Belarus, Moldova, Georgia, Armenia and Azerbaijan as part of a larger project entitled "Cities: An Analysis of the Post-Communist Experience". Our dataset contains urban audit indicators across various domains specific to our study, including some institutional measures at a city level (e.g. concentration of higher education establishments in a city; public expenditure as a proportion of GDP) and economic and social characteristics of cities and other indicators used controls in our study. We merge these statistical data with institutional country-level data, derived from the Polity IV data[21] and Heritage Foundation[22], EBRD transition indicators (EBRD Transition Reports, various issues),to shed some light on the effect of institutional settings at a country level on entrepreneurial entry. More specifically, the dataset is represented by 98 cities[23] covering Russia (54 cities), Belarus (6 cities), Ukraine (26 cities), Moldova (1 city-capital), Georgia (5 cities), Armenia (5 cities), Azerbaijan (1 city-capital)[24] .

2.3.2. Variable Definition

We use a number of small businesses taken in logarithms to measure entrepreneurship. According to national statistical offices small businesses are defined as firms with 50 employees or less (100 employees respectively in manufacturing sector). A number of small businesses as a measure of entrepreneurial activity have been widely used in a number of empirical studies (for discussion see Parker, 2009). As Figures B1-B3 show there is a huge variation in the number of small businesses across our sample. The number of registered small businesses is extremely low in Naryan-Mar, Russia, varying from 60 to 165 over the period of 1995-2008, and Nazran, Russia, varying from 128 to 1857 respectively. In 6 out of 98 cities the number of registered small businesses

[21] See M. Marshall and K. Jaggers, 2009. Polity IV Project: Political Regime Characteristics and Transitions, 1800-2008, Dataset Users' Manual, available from http://www.systemicpeace.org/polity/polity4.htm.

[22] For discussion see Beach, W.and Kane, T. 2008. Methodology: measuring the 10 economic freedoms. In K. Holmes, Feulner, E., & O'Grady, M. (Eds.), *2008 Index of Economic Freedom*: 39-55. The Heritage Foundation: Washington.

[23] In our sample city size varies from less than 50,000 such as Gori in Georgia, Naryan-Mar and Nazran in Russia to 10,500,000 residents in Moscow, Russia.

[24] Djankov's et al. (2002) study that preceded launching the Doing Business project, contains data for 1999. If there were little time variation in the data, we could introduce start-up regulation variables as time-invariant. However, after comparing Djankov data for 1999 and the Doing Business dataset for 2003, we discovered substantial variation in start-up regulatory measures over this relatively short time period.

over the 1995-2008 is below a thousand. These cities include Chernigov, Ternopil, Uzhgorod in Ukraine and Elista, Naryan-Mar and Nazran in Russia. At other extreme, Kiev, Moscow - capital cities ,- and Saint-Petersburg show high rates of entrepreneurial activity with the number of small businesses reaching more than 40,000 on average over the period of our analysis.

To test our institutional hypotheses we utilise measures at both city and country levels to account for the multilevel dimension of our data, and taking into consideration that the effects of institutional arrangements may vary depending on the level of regional aggregation. There is no universally accepted set of measures to test the effects of country-level formal institutional structures. Scholars have largely relied on what is commonly referred to as institutional outcome variables (Glaeser et al., 2004) which include survey indicators provided by the International Country Risk Guide, the World Bank measures of Governance Effectiveness; the World Bank's Doing Business indicators; Polity IV measures of political institutions, Fraser Institute, and the Heritage Foundation / Wall Street Journal indices. Among other our choice of country-level institutional variables has been driven by the need to avoid multicollinearity, which may both render some coefficient insignificant and lead others to appear significant because of over-specification.

To test the effect of banking reform (Hypothesis 1) we employ EBRD transition indicators, scored from 1 denoting little progress from a socialist banking system apart from the separation of the central bank and commercial banks; a score of 2 showing that a country has established internal currency convertibility and has liberalised significantly both interest rates and credit allocation; a score of 3 implying that a country has achieved substantial progress in developing the capacity for effective prudential regulation and supervision, and in establishing hardened budget constraints on banks by eliminating preferential access to concessionary refinancing from the central bank; and a score of 4+ representing a fully-fledged market economy with the institutional standards and norms of an industrialised market economy. This measure has been utilized by other scholars, looking, for example, on banking reform and development in transition economies (see Fries and Taci, 2002).

For the strength of property rights (Hypothesis 2), we use the Polity IV measure of efficient constraints on the arbitrary power of the executive branch of the government, named "constrains on executive". Some scholars have largely relied on what is commonly called the Heritage Foundation–Wall Street Journal indicator of property rights (e.g. Aidis et al, 2010; Estrin and Mickieiwcz, 2011). However, the Heritage Foundation variable integrates two dimensions of property rights, namely protection from arbitrary government and protection of private contracts. Following Acemoglu and Johnson (2005), we consider the former to be more important (see also Estrin et al. 2011 for the validity of this measure). Furthermore, the Heritage Foundation measure of property rights is highly correlated with the Heritage Foundation indicator of business freedom which is crucial to test our hypothesis 4. Respectively, a two-fold problem with the Heritage Foundation measure of property rights leads us to adopt the Polity IV measure "constraints on executive".

To measure the size of the local government we use a city-level indicator, defined as local government expenditure to GDP ratio (Hypothesis 3). Government expenditure to GDP has been utilized at a country level as a proxy for size of the government by a number of scholars (Sobel, 2008; Aidis et al., 2010; Estrin et. al., 2011).

To test Hypothesis 4 we use the Heritage Foundation business freedom index (BFI) which measures the rigidity of business regulation. It reflects various barriers to start, operate and exit business, and it scores from 0 to 100 with 100 denoting the highest degree of business freedom (Beach and Kane, 2008). We anticipate that using the more narrow World Bank Doing Business start-up regulation data in our analysis could be seen as more adequate, but there are two problem with the latter dataset. First, it does not cover the time period of our study. The World Bank Doing Business data starts from 2003, whereas our sample covers 1998-2003. Second, while institutions should be seen as stable, there is remarkable time variation in World Bank entry barriers indicators, Djankov's et al. (2002) study that preceded launching the Doing Business project, contains data for 1999. If there were little time variation in the data, we could introduce start-up regulation variables as time-invariant. However, after comparing Djankov data for 1999 and the Doing Business dataset for 2003, we discovered substantial variation in start-up regulatory measures (in particular, in those

related to time and cost to open a new venture) over this relatively short time period. Nevertheless, the number of entry procedures was the most stable indicator.

Finally, we use the number of universities in the CIS countries obtained from the "Universities in CIS" and "Universities worldwide information resources" databases[25] to test our Hypotheses 5a and 5c. We further interact it with our industrial controls, each at a time, but find that this interaction is only statistically significant with manufacturing/energy and mining industry that captures the effect of university-industry collaboration (Hypothesis 5b) Table B1 reports variable definitions and descriptive statistics, including our control variables. Table B2 shows the correlation matrix between variables used in this study.

2.3.3. Methodology

We use the following model to examine the determinants of entrepreneurial activity in a panel of 98 cities during 1995-2008.

$$S_{it} = \beta_1 S_{it-1} + \beta_2 X_{it} + \beta_3 Z_{it} + u_{it} \quad (1), \quad i=1,..., N; t=1,...,T$$

$$u_{it} = v_i + e_{it} \quad (2)$$

where S_{it} is our natural logarithm of the number of small businesses and S_{it-1} is its lagged value (predetermined variable). X_{it} is a vector of our two potentially endogenous variables, namely GDP per resident, the rate of unemployment, and the ratio of capital expenditure to GDP . Z_{it} is a vector of strictly exogenous control variables listed in Table B1. The error term u_{it} consists of the unobserved city-specific effects, v_i and the observation-specific errors, e_{it}.

The dynamic structure of equation (1) makes both the OLS and fixed effects estimators upwards and downwards biased respectively, and inconsistent, since the predetermined variable and endogenous variables are correlated with the error term. Therefore, to estimate equation (1) we use the System Generalised Method of Moments (SYS GMM) estimator (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond 1998). The use of this estimator allows to address econometric problems which arise from estimating equation (1). These include (a) the problem of potential endogeneity of some of our regressors, notably GDP per resident, the rate of unemployment and the ratio of capital investment to GDP; (b) the presence of predetermined variables - the lagged dependent variable S_{it-1} that gives rise to measurement error as it is correlated with past errors; (c) the presence of fixed effects which may be correlated with the repressors; (d) our finite sample. SYS GMM allows the predetermined and endogenous variables in levels to be instrumented with suitable lags of their own differences (Roodman, 2006).

2.4. Empirical results and discussion and discussion

Our empirical results are summarized in Table B3 reporting the results based on the three estimation methods, notably pooled OLS (specification 1); (2) panel fixed effects (specification 2); and (3) System GMM estimation (specifications 3 and 4).Comparing the results of all three estimators used, one can see that the results obtained from the System GMM model are superior given that: (a) the autoregressive term is positive and significant, and its value lies between the respective terms obtained by fixed effects (which provides the lower bound) and OLS (which provides the upper bound); (b) there is gain in efficiency; (3) the instrument set is valid as evidenced by the Hansen test of over-identified restrictions; (4) all variables of interest have expected signs. Thus the discussion of our results proceeds based on specifications (3-4).

[25] For more detailed information please see http://univer.in and http://univ.cc.

We find support for Hypothesis 1, suggesting that entrepreneurial entry is positively associated with the progress in banking reform. To the extent that the banking reform promotes financial development via elimination of financial market frictions, reduction in transaction costs and risks associated with financing start-ups, it eases borrowing constraints which can be particularly severe for small businesses. Our results are consistent with Beck et al. (2005), showing that developed financial institutions are particularly beneficial for small firms as opposed to large ones; Korosteleva et al. (2011) who find that financial development in transition economies facilitates SMEs' access to external funds; and Korosteleva and Mickiewicz (2011) who provide some evidence on financial liberalization, which is captured though the progress in banking reform in our present work, increases the total financial size of the individual start-up entrepreneurial project via the increased use of external funds.

We fail to find any support for the property rights hypothesis (Hypothesis 2).This can be explained by the fact that entrepreneurs choose to respond to institutional deficiencies, in our instance weak property rights protection, via employing various adaptive strategies such as, for example, a strategy of diversification: they choose to invest in unrelated businesses instead of growing their core businesses before "beginning to attract too much attention of the wrong sort" (Welter and Smallbone, 2011). Such strategies impose growth constraints on existing businesses, preventing many of them to exploit economies of scale. These consequences are particularly hazardous in the industries where the economies of scale play a leading role given that a possible expropriation or raiding of a firm may prevent a firm from growth and engaging in different forms of business cooperation.

Along with the executive constraints index we use a level of criminality at a city-level in an attempt to capture the effect of asset expropriation by rent-seeking private parties. Although the coefficient is negative, which is expected from the theory, it is not statistically significant. These results are followed by a discouraging effect of a larger size of the state on entrepreneurial activity (Hypothesis 3). Larger state is associated with authorities' higher ability to transfer wealth through a differential tax policy applied by regional authorities, and other corruptive practices (McCarthy et. al., 1993; Aidis et al., 2009; Aidis et al., 2010). Such policies of wealth transfer are short-sighted as increase in the taxation level could generate only short-term benefits for certain governmental officials, and can trigger many small and medium-sized businesses moving to the informal sector of the economy.

Our empirical evidence does not support Hypothesis 4 postulating that more flexible business regulations encourage entrepreneurship (Djankov et al. 2002) and overregulated environment constraints entrepreneurial entry (Grilo and Thurik 2005). Although the value of the coefficient of business freedom is positive, it is not statistically significant. Perhaps, the effect of business regulation was expected to be stronger in the early or mid years of transition, but with many CIS countries making significant progress in liberalising business entry regulation by the end of 1990s (as evidenced by the Heritage Foundation data on business freedom), business regulatory environment has become less of an obstacle compared to the issues of external finance availability and cost; or rent-seeking practices employed by the state).

We find that heterogeneity in entrepreneurial activity is largely explained by the presence of higher education institutions in a city (Hypothesis 5a). This effect is likely to work through various channels, including (1) human capital accumulation affecting the supply side of entrepreneurship with individuals with higher education being more likely to exploit new opportunities in the market and to set up a new venture (Barberis et al.,1996; Davidson and Honig, 2003); and availability of high-skilled labour which entrepreneurs with employment growth ambitions have access to; (2) positively affecting a change in a system of societal values and norms which are conducive to entrepreneurship; (3) through increasing individuals' perception of knowledge and skills needed to start a new venture (Busenitz et al. 2000), and finally (4) through knowledge spillovers that occur via collaboration between university and industry, which are captured via our interaction term between these two variables, providing support for Hypothesis 5b. We interpret this result as some evidence of the importance of agglomeration economies in terms of higher concentration of knowledge which

may lead to intensified exchange of ideas via collaboration between small businesses and research institutions. This as an important advancement given centralisation of research and development activities in the past. Even nowadays the research and development system in some CIS countries (e.g. Belarus) still largely reflects the Soviet legacy with extra-mural R&D organizations not business enterprises remaining the main and often only source of R&D (UNECE 2010). In summary, tighter links between university and industry may facilitate the development of strategic entrepreneurship in the region (Stenholm et al. 2010; Agarwal et. al., 2007;Agarwal et. al., 2010).

We also confirm our hypothesis 5c finding that the effect of the presence of higher education establishments in a city is one of the most dominant institutional effects being statistically significant at one per cent level and with one standard deviation above the mean leading to 32 per cent increase in the rate of entrepreneurial activity in the region (calculations are based on specification 3). This is higher than the effect of a size of the state with a one standard deviation increase in this indicator causing a 21 per cent decrease in entrepreneurial entry; and comparable with the effect of a banking sector with the progress in the banking reform by one standard deviation above the mean leading to 33 per cent increase in the rate of entrepreneurship, although the effect of the higher education is reinforced further through university-industry collaboration (specification 4). Furthermore, both the effect of the size of state and of progress in banking reform are statistically significant at 5 per cent level whereas the effect of higher education establishments is statistically significant at 1 per cent.

As regards other control variables we fail to find some evidence of the significance of market size, proxied by the logarithm of population density, although it fails fairly narrowly to pass the 10 per cent significance level and it is positively related to entrepreneurial entry. We find a significant and positive effect of air pollution, used as a proxy for agglomeration economies. We fail though to find any significant effect of capital investment and the rate of unemployment. Finally, our findings are robust to controlling for industry effects. The industrial effects on their own reveal that entrepreneurial entry is less likely to happen in the education industry given the public nature of these institutions and the importance of economies of scale in this industry.

2.5. Conclusions

In this study we have explored how heterogeneity in entrepreneurial activity across CIS cities is influenced by variation in key institutions operating at both city and country levels. We based our work on the institutional framework proposed by Scott (1995) and extended by Stenholm et al. (2010) advocating that the institutional environment is comprised of four key pillars including regulatory, normative, cognitive and conducive domains. We extend this theory to highlight the important role assumed by higher education institutions which while formally constructed within the regulative pillar, are embedded within the other three pillars to facilitate the creation of the environment conducive not only to entrepreneurial entry in general but also for the development of strategic entrepreneurship. More specifically, we argue that higher education institutions might affect entrepreneurial activity via (1) human capital formation which in turn positively affects the supply of entrepreneurs in a city as well as the quality of labour resources available to entrepreneurs; (2) shaping a system of societal values and norms which cultivate a positive attitude towards entrepreneurship; (3) affecting individuals' perceptions about knowledge and skills necessary to start up a business; and finally (4) knowledge spillovers which occur through close collaboration between small businesses and research institutions, and which have been actively promoted now in the CIS region via establishment of clusters as part of Europe's agenda to encourage sustainable growth via innovation and entrepreneurship in the region, including EU neighbourhood countries. Some examples of such cluster initiatives include Skolkovo innovation hub in Moscow, and its equivalent in Minsk. Saxenian (1994) argues that small firms benefit the most from positive knowledge spillover effects, citing examples of Silicon Valley in California and the successful transformation of the Hsinchu-Taipei region of Taiwan. Overall, the embeddedness of higher education institutions within all four institutional pillars makes them well placed to accelerate the formation of the environment conducive to entrepreneurial entry in CIS cities.

Our other results also suggest the importance of some domains of regulatory environment. More specifically, we provide some evidence that larger size of local authorities, associated with a higher ability of governmental officials to transfer wealth through various corruptive practices, disincentivise entrepreneurial entry, and progress in banking reform enhances it.

Our findings have important policy implications. On top of emphasizing the importance of further advancements in a banking reform crucial for promoting financial development and reduction in borrowing constraints for small businesses, the authorities should also adopt a complex approach in further reforming the taxation system (as part of addressing the larger state size problem) where reduction in the tax rates should be coupled with minimising the number/frequency of tax inspections and corruptive practices embedded in the "grabbing hand" model of government intervention (Shleifer and Vishny 1999), which are found to be forcing entrepreneurs to adopt strategies constraining business growth of their core businesses. Finally and most importantly, to promote sustainable growth in the region local authorities should invest heavily in higher education, and as advocated by Bowen and De Clercq (2008) and Saxenian (2007) to generate higher returns, this investment should specifically target entrepreneurial and technical education. Furthermore, to promote strategic entrepreneurship the local authorities should concentrate on encouragement of cluster development between universities and local businesses.

Chapter 3: Returns to patenting and training – panel study of the UK innovators[26]

3.1. Introduction

The valid estimates of the returns to patenting and training have always attracted significant attention among academic researchers, patent officials, policy-makers and top managers of the companies taking strategic decisions on training and intellectual property rights protection. As the number of patent applications has increased in Europe, Japan and the US (Kortum and Lerner, 1998, 1999; EPO Annual Report, 2003) and knowledge expenditure as an asset has become an integral part of the firm market value (Farooqui, Goodridge and Haskel, 2011)**,** policy-makers have argued that the models estimating the value of patents, training and education using simple application or grant numbers as well as bi-variate choice models of whether to invest in training and education are not satisfactory any more. The models used by academics and scientists do not always comply with the availability of data or do not allow to extract at least approximate returns to patenting and training from the available data sources making it more difficult for the managers to decide about filing a patent and an amount of funds to be spent on knowledge. Moreover, most of the indicators used for the innovative outcomes are skewed to the left with a major part of firms exhibiting zero innovation outputs.

Doing innovation and protecting it is important. It brings about higher bargaining and market power and enables the company covered by patents to charge higher prices for the innovation. At the same time this is not the only way to increase firm's innovative outcomes. Higher benefits from innovation and their protection come with a continuous investment in knowledge, such as training and education. Along with other investment in R&D, acquisition of machinery, equipment and software, different forms of design and others**,** knowledge expenditure (including training and education expenditure) is considered to be one of the most important factors that drive growth. The impact of knowledge investment (including training and education expenditure) as an intangible asset, contribute to the labour productivity growth of the firm, and overall in the UK market **(**Farooqui, Goodridge and Haskel, 2011).

The purpose of this study is to estimate the private returns to patenting and training for the panel of the UK innovators over the period 2002-2009, and the incentives that patent protection offers for further investment in innovative training and education. Additionally we also aim to quantify the level of patent propensity for the UK innovators, which is a proportion of innovations for which patent protection was sought. Firms' patent propensities vary widely across industries. Moreover, within each industry, there are significant discrepancies between the number of pending patents and the number of innovative products launched to the market. Some products are protected by multiple patents, while certain patents are never embodied into tangible products (Branzei and Vertinsky, 2006). Given the CIS data propensity to patent for the UK innovators has not been estimated, but assumed (Arora et. al. 2011), we use most recent panel and cross-sectional data, and correcting for the endogeneity of innovative training expenditure as a factor affecting innovative outcomes. The gains from quantifying firm's patent propensity is not limited to the UK, but the model offered could be applied to any firm or industry in any country in order to measure the indicator of interest given a limited firm level data availability. This paper also focuses on how the knowledge expenditure on innovative training and innovation outcomes, proxied by the new product revenue (NPR) are affected by the other factors.

While there have been many studies on identifying the returns to patents and training (Kortum and Lerner, 1999; Schankerman 1998; Pakes and Simpson, 1989; Arora et. al., 2008; Leiponen and Byma 2009) and even those working with the UK micro-level data on innovative companies and R&D performers (Farooqui, Goodridge and Haskel, 2011; Hall et. al., 2011; Arora et al., 2011), the returns to innovative training and patenting have not yet been precisely identified. Neither the incentive that patent protection provides for further knowledge expenditure, although

[26] This essay is the result of collaboration with Dr. Yulia Rodionova from Leicester Business School (UK) I attempted to introduce my own contribution.

reverse link of the impact of knowledge spending on patents for the US has been explored by Artz et. al. (2010). Arora et al. (2011) estimate the interval of patent premia for the UK innovators using the Community Innovation survey data on the UK for 1997-2006. However, this interval is rather wide (0.4-2.87) and it has obtained using the assumptions on a patent propensity. The ability to use the real values of the patent propensity for the UK business would enable the researchers to calculate the patent returns more precisely and provide better understanding for the intellectual property rights policy in the UK.

At the same time there is another gap in the research on the effect of patent protection in inducing more training and education expenditure relevant for managerial policy. It is not clear what would happen with training expenditure if a company chooses to protect its innovation by holding a patent. Comparing both returns on patenting and training, we could shed some light on a substitute or a complementary effect of patent and training expenditure returns in terms of revenues coming from new product sales to the market.

There are two main contributions of this study: methodological and empirical.
Modifying the model developed by Arora et al. (2011) for estimating the returns to patenting for the UK businesses, we employ a new approach to estimation of patent premia and returns to innovative training. Our approach extends Arora et al. (2008, 2011) using matched CIS and BSD data on new product revenues for a panel of 4049 firms over the period of 2002-2009. The model estimates patent premium using the data available on patent propensity for 4049 UK innovators, where we explicitly assume that it takes extreme values of 1 if the firms holds a patent, and of 0, if it does not. This assumption based on data, enables us to estimate the patent premium interval more precisely. When compared the results obtained by Arora et al. (2011) and from our study, the patent premia is identified more precisely.

Our first empirical contribution consists of quantifying the patent propensity for the UK innovators which is 1/3 or less, and the value of the patent premium which varies between 191 and 201%. Here the patent premium refers to the additional new product revenue from holding a patent. However, one of the main limitations of the study is that we cannot trace if a company holds a patent in CIS6 due to the change in the corresponding question between CIS5 and CIS6 surveys.

The second empirical contribution is in estimating the implied increment to the new product revenue due to higher expenditure on training and education: we obtain the elasticity of NPR with respect to innovative training and education expenditure, which is within the range of 15 to 36 % for the different waves of CIS. Moreover, we find that innovative training expenditure has a higher effect during the crisis years and discuss why it could happen. We also establish that the returns on patents and innovative training are different between the young firms (start-ups) and mature firms (incumbents) within the panel.

We make an original contribution to the literature by using such data on training as the amount of expenditure on innovative training, as opposed to using a dummy variable on the incidence of training. We then infer from it and use the data on innovative training only – hence, more exact estimates and lower training premia obtained than in the previous studies on returns to training (see Table C1).

The results are robust in both across cross-sections and panel data estimations as well as using different estimation techniques: the sign and significance of the coefficients do not change, although the value of the parameters becomes more precise. Instrumenting innovative training gives an additional increase in the estimation efficiency and consistency: in the instrumented regressions, the relevant tests support the significance of the instruments and their fit to data. Test of goodness of the IVs is performed and is satisfied, which does not always happen in the works described in the study. The instrumentation is executed using the instruments within the current dataset, rather than using lags, which could have potentially decreased sample size. Results still hold while using different estimates for the panel data: OLS, fixed and random effects, iterative non-linear likelihood estimation. We also experimented with a new technique introduced by Baltagi (2008) of using the random effects with instruments in a panel.

The essay is organized as follows. Section 3.2 presents the literature overview on the returns to patenting and training, as well the incentive that holding a patent provides for further investment in training and education. The second part of Section 3.2 presents a theoretical model linking patents, training and innovative outcomes. Section 3.3 describes research methods, discusses identification strategy and offers data description. Section 3.4 discusses the results of the analysis and contributions to the existing research. Section 3.5 discusses future research and policy implications, and concludes.

3.2. Theoretical Framework and Literature review

3.2.1. Previous research

In practice, the question of returns to knowledge investment is very complex. In addition, issues related to the legal and economic aspects of patents, developing special skills through training and education programmes are difficult to catalogue and to categorize in questionnaires and surveys. Nevertheless, an attempt to investigate systematically the possible reasons for the differences in returns to patenting and knowledge expenditure has been made. The search for valid estimates of economic returns to patenting and training has raised significant attention among economists, lawyers and policy makers. This is paralleled by an increase of the relevance of other intangibles for firm performance and profitability, leading to new questions in innovation and strategy as to how patents and knowledge expenditure increase firm's revenues and profits (e.g. Kortum and Lerner, 1999; Arora et. al. 2008). In the two subsections presented below, we review the literature first, on the returns to patenting, and second, on the returns to training.

3.2.1.1 Returns to patenting

Firms do use various methods to protect their inventions, including patents, and different forms of the first mover advantage (e.g. Levin et al., 1987; Cohen, Nelson, and Walsh, 2011). These instruments of protection and the nature of innovation vary across industries and firms of different size (Cohen and Klepper, 2006). Patents serve to protect the firm's technological knowledge and embody an exclusion right and provide an incentive for the firm to invest in innovation, knowledge and marketing activities (Greenhalgh and Rogers, 2006). This is our link between the legal protection of innovation and further investment in training and education. As indicators, patents transmit information about the firm's technical knowledge and the intention to protect its inventions. Patent is a signal of companies' engagement in new product / process development as new products / processes may require protection by patents (Mendonça**,** 2004). Similarly, patents can be used to detect companies' engagements to enter new product or new geographic markets. This will subsequently affect knowledge expenditure including innovative training.

Literature search on "Returns to patenting" leaves us with 27 academic papers published over the period of 1983-2011 with the majority of them including the last publication in a Research Policy Journal. The first paper dealing with returns to patenting is Scherer's (1983) "Propensity to patent". It analyzed the relationship between knowledge expenditures viz. R&D and invention patenting by 4,274 lines of business in 443 U.S. industrial corporations. It has shown that the number of patents tends most frequently to rise in proportion to R&D; this tendency has however exhibited diminishing returns.

Above work was followed by Horstmann et al. (1985) who first started a discussion on the costs of disclosure which can more than offset the private gains from patenting with an effect of "stronger" patents on incentives to innovate. The private returns to patent protection were further explored by Pakes, Simpson and Schankerman in the 1980s in their examinations of European firms' patent renewal decisions (e.g. Pakes, 1986; Schankerman and Pakes, 1984; Pakes and Simpson, 1989). These works utilized a patent-renewal data showing that they can be used to derive quantitative estimates of the private value of patent protection, such as annual renewal fees to

maintain patent protection on inventions. Under the assumption that patentee's decision on patent renewal results from profit-maximization, data on patent renewal rates and fees was used to infer the private value of patent protection (Pakes and Schankerman, 1984), which is different from the income derived received due patenting.

In the early 1990s Harabi (1995) published the paper on the economic returns on technical innovations as an important factor for driving individual inventors and innovators. Since the economic returns on technical innovations were difficult to measure directly, many researchers have attempted to investigate them indirectly through qualitative techniques and by examining the effectiveness of various means of protection of invention, including patents and secrecy, and thus leaving aside the quantitative measure of returns, which had been under-researched.

Patent protection per se yields monetary value and provides an incentive for more research expenditure including training and educational programmes that generate the underlying inventions. This idea has been suggested in Schankerman (1998), which is considered to be one of the earliest seminal works on returns to patenting and the resulting incentives for innovation. The value of a patent is represented by the incremental returns generated by holding a patent, above and beyond the returns that could also be earned by using the second-best means. He argues that a value of patent protection varies across inventions because of the differences in the underlying private value of the inventions and in the effectiveness of patents in protecting them. The research was then extended on patent renewals by investigating the private value of patent rights in France during the period 1969-1982 in pharmaceuticals, chemicals, mechanical, and electronics using the previously developed Pakes and Simpson (1989) techniques.

Research on 'Small firms, returns to cooperative innovation and patenting' was recently published by Leiponen and Byma (2009). Their study examines small firms' strategies for capturing the returns to investment in innovation and establishes the small firms' strategies, which turn out to be qualitatively different from those found in the earlier studies of both small and large firms. The authors conclude that most of the small firms use informal means of protection, such as speed to market or secrecy that proves to be more important than patenting for a small firm. Only firms with university cooperation and large firms —typically R&D intensive as well as knowledge-based small firms were likely to identify patents as the most important method of protecting their innovation and securing returns to patenting. This, however, does not mean that the returns to innovation for small firms are lower than those for large firms –an issue to be further investigated.

During the years 2003-2007 several cutting-edge research papers turned up. Greenhalgh and Rogers (2006) estimated the value of innovation and its link with competition, R&D and intellectual property. This is the first study using a new data set on market valuations of UK companies and their knowledge expenditure including R&D during 1989 – 2002 based on the technological classification originating from Pavitt (1984). The main result is that the valuation of R&D varies substantially across UK sectors while on average, firms that receive only UK patents tend to have no significant market premium. In direct contrast, patenting through the European Patent Office does raise market value. To explore further the reasons of low UK market premium on patenting the paper links competitive conditions with the market valuation of innovation and finds that the sectors that are the most competitive ('science based' manufacturing) have the lowest market valuation of R&D. Furthermore, firms with larger market shares tend to have higher R&D valuations, as well as positive return to UK patents. This evidence supports Schumpeter's (1939) ideas by finding higher returns to innovation in less than perfect competitive markets and contradicts Arrow (1962) who argued that, with the existence of intellectual property rights, competitive market structure provides higher incentives to innovate.

Most recent research on the value of a patent and returns to patenting is implemented by Bulut and Moschini (2009), Acosta et. al. (2009) and Artz et. al (2010). Bulut and Moschini (2009) study the US universities that have increased their involvement in patenting and licensing activities through their own technology transfer offices. They find that only a few US universities are gaining high returns, while others are continuing with negative or zero returns. Artz et. al. (2010) estimated the relationship between a firm's commitment to research and development including training and

education of workers and its innovative outcomes. They have analysed two innovative outcomes on a sample of 272 firms in 35 industries over 19 years: invention, which focuses on the development of new ideas; and innovation, the development of commercially viable products or services from creative ideas. Their main findings are that knowledge spending is positively related to patents, however the reverse relation have not been examined. The paper deals with increasing returns to scale to knowledge spending, and it is consistent with economic arguments for the advantages of scale in innovation, while it contradicts the latest research results. Consistent with their previous work, a negative relationship is found between patents and both returns on assets and sales growth. While these findings were unexpected, they are intriguing and call into question the value of patents as protection mechanisms if they generate negative returns. The authors argue that these results may result from the rise of strategic patenting, where an increasing number of firms are using patents as strategic weapons. This is to be further investigated with the micro-level data. On the contrary, a positive relationship is found between patents and new product announcements. This fact can prove why patents and knowledge expenditure can be associated positively with a fraction of income generated by new products, rather than with total sales of asset returns.

The most recent work on returns to patenting is by Patel and Ward (2011) who estimated annual measures of Tobin's q and the data on citation patterns related to the area of science a firm patents. The main finding is that markets positively reward firms when patents are granted in terms of daily abnormal stock returns. Should a firm's patent portfolio be cited, a firm's market value increases instantly in terms of stock returns. Therefore, the case of having a patent could hypothetically determine higher incremental returns, leaving new space for further research. Finally, the study described below is complimentary to the research supported by the Intellectual property Office (IPO) UK completed in 2011 by Arora et. al (2011). Using the data on the CIS and BSD survey from the UK innovators they attempted to estimate the returns from IP protection and the way it enhances potential revenues that firms can earn from their innovative activities. The main assumption was that firms can earn larger revenues and profits (due to patenting), although the data was limited in terms of patent propensity for the UK business which did not allow them to estimate precisely the patent premia. Employing the data on patent effectiveness for the firm managers they estimated a certain intervals of a patent premium at each level of assumed patent propensity ϕ_i. Please see the Table C4 in Appendix.

3.2.1.2. Returns to training, drivers of training and innovative outcomes

Maier (1965) defines abilities as being of two kinds: abilities arise without training (aptitudes) and modified abilities introduced by training (achievements). Achievements are realized abilities and the relationship between the achievements and aptitudes is expressed as achievements being an aptitudes reinforced by training. In the context of management literature Herron and Robinson (1998) Maier's formulation of achievements could be expressed as:

Skills =Aptitudes x Training

The Maier's word "abilities" gives way to the world skills and training being an integral component of it. Skills needed for "win-win" strategy are the result of both natural aptitudes and training. Herron and Robinson (1998) emphasize that "training" may take place in multiple ways: it may mean either experience or a formal training whenever skill is exercised. Possession of skills will affect a motivation to use them, furthermore these entrepreneurial characteristics and skills will affect entrepreneurial behavior and eventually business performance (Herron and Robinson (1998, p. 10). Training may also affect psychological characteristics of entrepreneurs providing more motivation through skills acquisitions (Begley and Boyd, 1987). From the practical point of view, a manager would like to know what will be additional revenue for a business if aptitudes are reinforced by training given a certain amount of dollars spent.

Existing empirical studies surveyed analyzing the impact of training on business' performance concentrate on the general measures of training, rather than on the expenditure on training for

innovation, which complicates the direct comparison of the economic effects of innovative training expenditure on the new product revenue. For example, Marotta et al. (2007) present a study of Chilean firms with as a qualitative measure aggregated into several categorical groups and of how important training is perceived. This precludes the authors from computing the corresponding elasticity value with respect to the innovative training expenditure and therefore the contribution of training to skills, behavior and performance. Similar analysis carried out by Acemoglu (1997), although he analyzed innovation and training decisions, not directly the training premia (i.e. returns to training expenditure). This research could fit our analysis streamline, if the author would speak about returns on training expenditure, rather than identifying a certain incentives for employees to invest in general training - worker's prospective approach. In our paper an employer, not employee bears the cost of training without fixing a market type and the division of cost between worker and a firm as opposed to Acemoglu (1997). A summary of an empirical previous research on the impact of training (broadly defined) on productivity is presented in the Table 3.1 below.

As regards the drivers of training, our paper employs standard controls as found in much of the literature (see, e.g., Bishop, 1991, 1997; Galia and Legros, 2004; Baldwin and Johnson, 1995), subject to their availability in our data as well as industry dummies (Barrett and O'Connell, 2001; Arora et. al. 2008). We next turn to the discussion of the theoretical model of the effect of patenting and innovative training on the new product revenue of a firm.

Table 3.1. Existing estimates of the impact of training on firm's performance.

Study	Dataset	Method	Performance measure	Data type/ Sample size	Results
Hansson (2007)	The Cranet survey	OLS, Probit	(1) the top 10 per cent; (2) the upper half; or (3) the lower half of all firms in the sector: profitability.	5,824 private-sector firms in 26 countries	Positive relationship between the number of employees receiving training and being in top 10 per cent of profitability among other firms in the same sector.
Bishop (1991)	EOPP (1982) survey sponsored by the National Center for Research in Vocational Educational	Cross-sectional analysis in levels and logs, OLS difference analysis	Productivity growth	2594 firms	ROI on 100 hours of new hire training ranged from 11% to 38%.
Holzer et al. (1993)	Survey sent to Michigan firms applying for state training grants	Fixed effects	Scrap rates	157 firms	Doubling of worker training reduces scrap rates by 7%; this is worth $15,000.
Ichniowski et al. (1987)	Field interviews of 45 steel finishing lines in the US – monthly productivity data	OLS, Fixed effects	Productivity	2190 observations from 36 lines owned by 17 different steel companies	Positive effect of high and low incidence of training on productivity in steel finishing lines
Bartel (1994)	Columbia HR Survey (1986)	OLS, Probit	Value added per worker	155 US enterprises in 1986	Firms operating at less than their expected labour productivity in 1983 implemented training programmes which resulted in them achieving higher productivity growth between 1983 and 1986, by 6% per year
Black and Lynch (1996)	National center for the Educational Quality of the Workforce (EQW) National Employers Survey (1994)	Cross-sectional OLS	Dollar value of sales, receipts or shipments in 1993	US National Employers' Survey for 1994, 617 firms, matched with the Census Bureau's Longitudinal Research Database for the panel study	Per cent of formal off-the job training in manufacturing, as well as computer training in non-manufacturing sector is positively related to productivity in the cross-section.
Black and Lynch (2001)	EQW National Employers survey (1987-1993)	Panel First differences estimation of productivity, then regressing residual on training variables	Productivity	Panel data for 1987 to 1993	Number of workers trained in a firm is not statistically significantly linked to productivity (no effect on the establishment-specific residual in the panel estimation in the manufacturing sector).
Barrett and O'Connell (2001)	Surveys of enterprises in Ireland in 1993 and 1996-1997	OLS and First differencing of panel data	Productivity	Surveys of enterprises in Ireland in 1993 and 1996-7	General and all training is positively related to productivity; specific training has no significant impact.
Cassidy et al. (2005)	Total Factor Productivity Survey (1999 – 2002)	Panel data fixed effects estimation	Total Factor Productivity	Foreign-owned and indigenous Irish manufacturing with > 10 workers	Plants engaged in training have a TFP advantage of 0.3 percent, ceteris paribus
Tan and Batra (1995)	World Bank survey	OLS; Probit using predicted Training dummy to Instrument training dummy	Log of Value added	300-56,000 firms by country	Predicted training has positive effect on value added; effects range from 2.8% to 71% per year
Thornhill (2006)	Survey of Canadian Manufacturing firms	Weighted Heckman regression, Logit, OLS	Innovation; Revenue growth for high technology and low technology firms separately	845 firms	Training is not statistically significant for either group; Training positive significant for innovation
Huselid (1995)	1992 survey of human resource practices	Cross-section, as well as Fixed effects	Tobin's Q and gross rate of return on capital	968 firms	High performance practices had significant effect in cross-sections but disappeared in the fixed effects study
Bassi (1984)	Continuous Longitudinal Manpower survey (1975-1978)	Fixed effects/random effects/serially correlated error.	Worker earnings	Earnings of white and non-white males and females	While women are found to benefit significantly from manpower training programs, no such effect was found for men

Source: Bartel (2000) with the authors' additions and compilation.

3.2.2. Theoretical Model.

As the starting point of our analysis we modify a theoretical model developed by Arora, Athreye and Belitski (2011) which is used to analyze the private returns to patenting and R&D incorporating the trade-offs of holding a patent postulated by Schankermann (1998). The model is extended to quantify returns to innovative training and the benefits coming from a patent protection of innovation for the investment in training. From the CIS we first create a measure of the total revenue from new products, NPR as follows

NPR=TR x % of revenues from new products (1.1)

We consider as new products (N_1) those products that are new to the industry – and not just to the firm. We can get TR and % of revenue from new products from CIS survey panel data for 2002-2009, or from BSD survey and the percentage of revenues from new products from CIS.

$$NPR \equiv P_1 N_1 Q_1 \quad (1.2)$$

Where P_1 = average price of new products, N_1 = number of new products, and Q_1 = average quantity of new products.
We assume that

$$P_1 Q_1 = PQ(1-\phi) + PQ\phi\delta \quad (1.3)$$

where P is the price of products and Q is the quantity of products sold.

This equation says that the average revenue per product is a weighted average of revenue created with and without patent protection, and that the revenue for items with a patent protection is greater following Schankerman (1998). ϕ is the share of products for which patent protection was sought, called patent propensity, unknown from the ONS UK and IPO UK data as no special surveys have been undertaken so far, and δ is the patent premium.

Finally, we assume a production function linking the number of new product innovations to investments in innovative training, $N_1 = f(T)$. For the moment, we do not specify the functional form of f (). Note that T is the amount of money spent on training for product innovation, not the total training expenditure. We will measure T as λ(Total training expenditure), where λ = share of training expenditure devoted to product innovation in the focal industry. Taking into account the nature of the question used in a survey: "the amount of expenditure in each innovation activity, either from management accounting information or using informed estimates on training" and the fact that all companies in a sample are classified as innovators, we assume that λ=1. Thus, the firm's total training expenditure in our case is entirely related to an innovation activity.
Combining with (1.3) and (1.2), we get

$$NPR = PQ(1 - \phi + \phi\delta) f(T) \quad (1.4)$$

Taking logs, and transforming the model into econometric form we get

$$npr = p + q + \ln(1- \phi + \delta\phi) + \ln(f(T)) + \varepsilon_i \quad (1.5)$$

where lowercases denote natural logs.

Now, if we specify an appropriate form for f(T), we can estimate (1.5) as a non-linear least squares (where ϕ is not known and δ is a parameter to be estimated). The econometric model of (1.5) becomes

$$npr_i = A + b_1 \ln(T_i) + \ln(1- \phi_i + \delta\phi_i) + \varepsilon_i \quad (1.5')$$

Where A = p+q + intercept.

There are two issues. First, (1.5') imposes a specific non-linear specification, albeit one that naturally follows. Second, T is endogenous. In particular, it will depend upon unobserved firm specific differences in price and quantity. Put differently, demand shocks (which affect p and q) will also affect innovative training expenditure.

This can easily be seen by writing $p = \mu_p + \varepsilon$, where μ_p is the average (across firms) price and ε is a firm specific component of price. All else equal, if ε is high, T will be higher too. The obvious way out is to find an instrument for T. A natural instrument for T for (1.5) is any variable that affects cost of inputs, provided those are independent of demand shocks. We have explored measures from the Community Innovation Surveys (CIS), such as the importance of increased capacity for production or service provision to product (good or service) and/or process innovations introduced scaled (0-3); and the importance of knowledge factors as constraints to innovation activities or influencing a decision not to innovate viz. lack of information on markets, as instruments. We also attempted to find the Arellano-Bond type instruments (see Arellano and Bover, 1995), i.e. the first lagged values of innovative training expenditure as an instrument for T, however the availability of data has considerably decreased the sample increasing the risk of selection bias. Moreover, the instruments used pass all the statistical tests and have economic justification and are also highly correlated with the instrumented variable.

In our CIS data ϕ_i is unobserved and therefore δ could not be identified. We modify the original model (1.5'), given our data constraints and the limited information available from the ONS micro-level data such as the BSD and CIS surveys to be able to estimate an equation that relates new product revenue (NPR) to patent protection and knowledge expenditure. The modified model can be written in the following form:

$$npr_i = A + b_1 \ln(T_i) + \ln(1 - \phi_i * (1-\delta)) = A + b_1 \ln(T_i) + \phi_i (\delta - 1) + \varepsilon_i \qquad (1.6)$$

where the last equality holds since in the vicinity of x=0, y=ln(1+x) can be approximated by y=x.
Since patent propensity ϕ_i is observed (equals 1 for a firm holding a patent and zero when patent protection not used) we can quantify the returns to patenting in addition to speaking about the direction of a relationship between patent protection (holding a patent) and the new product revenue.
Now we can rewrite (1.6) as the reduced form

$$npr_i = A + B_1 \ln(T_i) + B_2 x_i + e_i \qquad (1.7)$$

$$\text{Therefore, } x_i = \phi_i \text{ and } 0 < \phi_i < 1 \text{ and } B_2 = (\delta - 1) \rightarrow \delta = B_2 + 1 \qquad (1.8)$$

Assuming firms choose their innovative training investments to maximize returns, so that actual NPR and T are jointly determined by underlying firm and industry characteristics (denoted by X) thus the estimating equation becomes

$$T_i = C_1 + \Sigma X_i \lambda_i + B_i x_i + e_2 \qquad (1.9)$$
$$npr_i = C_2 + \Sigma X_i \theta_i + B_1 \ln(T_i) + B_2 x_i + e_2 \qquad (1.10)$$

where C_1 , C_2 are vectors of intercept terms in equations (1.9) and (1.10) respectively, λ_i is a vector of unknown coefficients of the exogenous variables in equation (1.9), θ_i is a vector of unknown coefficients of the exogenous variables in equation (1.10), X_i is a vector of exogenous variables (controls) in both equations; T is innovative training expenditure.

Note that (1.10) is very similar to (1.7). However, by estimating (1.9) and (1.10) together, we accomplish two objectives. First, we improve the efficiency of the estimate, because parameters are

jointly determined in the two equations. Second, we are able to estimate the incentives offered for innovative training due to patent protection and the other factors. The econometric model of equation (1.10) based on the panel data could be presented as follows:

$$npr_{it} = C + \Sigma X_{it}\,\theta + B_1 \ln(T_{it}) + B_2 x_{it} + e_{it} \quad (1.11)$$

$$e_{it} = v_i + u_{it} \quad (1.12)$$

where i denotes a reporting unit (i=1, …,n) and t - the time period (t=1,..,T); C is a vector of intercept terms, θ_{it} is a vector of unknown coefficients of the exogenous variables, X_{it} is a vector of exogenous variables (controls); T_{it} and x_{it} are the variables of interest: training expenditure and patent protection of a firm i in period t. The error term e_{it} consists of the unobserved individual-specific effects, v_i and the observation-specific errors, u_{it}.

Our study is also subject to certain limitations. For instance, we do not analyze all the different ways in which patenting might affect innovation, however, we do analyze the new product income due to the existence / nonexistence of patent protection overall and for different enterprise age. Given our main focus is on studying the private returns to innovative training. Thus, while we control for training spillovers including patenting, we do not model the impact of training on those spillovers. Nor do we consider the impact of training on entry and associated innovation.

3.3. Data and Methodology

3.3.1. Identification Strategy and Research Hypotheses

In general, many indexes are being used to measure innovation. Since R&D input index reflects only the input on innovative activities, it is hard to consider it as an actual process of innovation. Patent as an R&D output index also cannot be used to measure the actual amount of innovative activities in that not all the R&D efforts of a company turn into a patent; and not all innovations are eventually patented (Acs and Audretsch, 1987a, 1987b; Arora et. al, 2008).

Commonly used indicators of innovation outcome based on Community Innovation Survey (CIS) data include percentage sales of products that are new to the market or to the firm or significantly improved compared to sales of other products. A review of the advantages and disadvantages of such indicators and some of the studies that employ them is provided by Vásquez-Urriago et al. (2011). Their main advantages are that they provide a measure of the economic success of innovations (in terms of income which comes from sales of the innovative products), are applicable to all sectors, allow types of innovations to be distinguished, and allow the definition of continuous variables, which contribute to the development of econometric analyses (Negassi, 2004). Their limitations are that they are sensitive to product life cycles and markets, which may differ in the context of competing companies (Kleinknecht et al., 2002; Frenz and Ietto-Gillies, 2009). The number or a share of products in the market gauged the success of firms in developing and introducing new products is used as a substitute for a share of new products and therefore, new product revenue. This measure was among the most widely used indicators of the firm's innovative outputs (Deeds and Hill, 1996; Harmon et al., 1997; George et al., 2002). In particular George et al. (2002) used various indicators for a firm innovation and performance outcomes among publicly traded biotechnology companies, such as the number of patents issued to the firm; the number of products in the market introducing new products; the number of products under development. New products were viewed as the forerunners of a company's future market offerings, and key stakeholders were likely to weigh this variable heavily in determining the company's viability. For the robustness check in this paper two indicators: sales of products that are new to the market per employed (in 000s £) as an indicator of an innovative outcome and new product revenue per employee as an indicator of an innovative

performance are explored[27].

New products development using patents as an instrument to protect its innovation by a firm may lead to increase in the market share and bargaining power which allows the firm to charge higher prices for the innovation and may result in increasing knowledge expenditure to boost future innovative outcomes including expenditure on innovative training. Consequently trained personal will ensure higher revenues and productivity. We define patent premium as the additional revenue from been able to protect its innovation on the assumption that firms earn more per unit on innovations that are protected by patents (Arora et. al, 2008). Training premium could be defined as the additional revenue from knowledge expenditure in a form of innovative training and education aimed to improve personnel skills, abilities and productivity. Our research hypotheses could be postulated as follows:

Hypothesis 1: Innovative training provides higher new product revenue.

Hypothesis 2: New product revenue is higher for business that holds a patent (positive patent premia).

Moreover, higher revenues generated by patents will push firms to undertake more knowledge expenditure which includes innovative training and education.

Hypothesis 3: Patent protection increases business' knowledge expenditure on innovative training.

This study highlights a number of important features. First, we use the latest matched panel data sample of 4049 UK innovators based on the UK Innovation survey available at ONS from October 2011 for the period 2002-2009. The survey is built on the responses to the UK part of the Community Innovation Survey (CIS). CIS performed on 3-4 year basis by all 27 European Union Members with the main objective to understand innovative business better. In this study we the CIS and BSD matched databases are very powerful and provide data for a large sample of firms over the eight years. Since the survey is CIS-based, this measure can be replicated in other European countries, which will enable the development of stylized facts. Our study could also be useful for the Northern American innovation research enriching already existing surveys such as Carnegie Melon Survey, Science, Innovation, and Electronic Information Division of Statistics Canada Surveys (Branzei and Vertinsky, 2006). Our data provide quantitative evidence of the benefits received from patent protection and training for the UK innovators across all sectors.

Second, we employ the approach that relates CIS and BSD data on new product revenues, patent protection and knowledge expenditure on training for the UK innovators. Using parametric techniques including 2SLS and Tobit enables us to evaluate the training premium and returns to patenting as well as the inducement to invest in training for each round of CIS, discovering the changes in ex-ante and ex-post economically constrained times (2007-2009). These differences however could not be estimated for the patent premium and the inducement that patent protection provides for investment in training for the crises period 2007-2009. The reason for this is inconsistency between CIS4-5 and CIS6 question on the usage of patent protection. Using cross-section estimation will allow us to estimate the relationship between patent protection and innovative outcomes as well as training premium for each of three periods for average firms and for different points on the dependent variable distribution (right-censored and uncensored observations in Tobit estimation).

Third, we use panel data estimation with an extension for start-up firms and mature companies split to deal with unobserved heterogeneity across the firms of different age and increase the efficiency of the estimation. We also use industry controls generated in large six groups to control for

[27] The results obtained by using the new product revenue per employee as a dependent variable in the model (1.9) and (1.10) confirmed the results reported in the paper. The significance and the direction of relationship between the innovative outcome, patent protection, training and other control variables remained stable across various the estimation methods. This is also explained by the correlation coefficient between two innovative measures (sales of products that are new to the market per employed (in 000s £) and new product revenue per employee) which is 0.98.

unobserved heterogeneity across sectors. The definition of a new venture varies across studies. Depending on the industry setting, it can take between 8 and 12 years until companies mature (Zahra, 1996; Rosenbusch et. al., 2011). Within the scope of this analysis, we use an average age of 10 years as a cut-off point between young and mature firms.

Fourth, the instruments chosen are treated with cautious as the integrated effect moderate the relationship between training expenditure and firm innovative outcome (Zhuang et. al., 2009). Unlike the Arellano - Bond type instruments (Arellano and Bond, 1991; Arellano and Bover, 1995) viz. lagged values of training expenditure, instruments derived within CIS survey will not shrink the sample and robustness of the estimates could be controlled by performing F-test on instruments. Deriving the instruments within a sample does reduce the number of firms from the CIS survey however does not change the sample properties. We also experimented with lagged training expenditure, however due to a small sample bias we do not feature those results.

Lastly, there are several estimation issues of the equations (1.9-1.10). A first estimation issue is that we have three cross section models, which do not allow us to control for unobservable individual heterogeneity, however allows controlling for the drivers and causes in each round of CIS driving more precise conclusions. We overcome the problem of unobservable individual heterogeneity using panel data estimation techniques (Baltagi, 2008).

Second issue is related to the characteristics of our dependent variables, which is double censored, as firms can have none or all sales from new to the market products and hence none or all sales from new to the market products per employee. There are several different ways of estimating such a variable using parametric techniques (see Wooldridge, 2002; Cameron and Trivedi, 2005; 2009). A double censored IV Tobit model will account for this fact. This is used in several of the empirical analysis (Negassi, 2004; Faems et al., 2005; Laursen and Salter, 2006).

Third issue is that, by estimating a system of equations in the first stage of our analysis (1.9-1.10) we accomplish two objectives. First, we improve the efficiency of the estimate, because T is endogenous. Second, we are able to estimate the incentives offered for training expenditure due to patent protection[28]. The validity of our instruments is confirmed by a number of tests presented in Table C1. The first one is the Hansen's / Sargan's J statistic for overidentifying restrictions: the joint null hypothesis is that the instruments are valid, i.e., they are uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. If the test fails to reject the null hypothesis, then all instruments used are considered exogenous. The second one is the Kleibergen-Paap LM statistic, which tests whether the equation is identified, i.e., that the excluded instruments are correlated with the endogenous regressors. A rejection of the null indicates that the matrix of reduced form coefficients is full column rank and the model is identified.

3.3.2. Data and variable description

In recent years, many studies on innovation have used CIS-type data. CIS data are popular for analysing innovation because (i) they allow comparable indicators to analyse inter-country and intertemporal differences and develop robust empirical evidence, and (iii) they are usually conducted by national statistics offices which are experienced at data gathering, and conduct extensive pre-testing and piloting to check interpretability, reliability and validity (Laursen and Salter, 2006, Frenz and Ietto-Gillies, 2009; Arora et. al., 2011).

The dataset used in this paper is based on two independent, albeit mergeable, datasets, viz. the CIS[29] surveys conducted bi-annually by the Office of National Statistics (ONS UK) and Business Survey Database (BSD) which we use to gain information on firm's ownership, status (MNE or not MNE), the year of establishment and SIC sector activity. While the CIS provides detailed information on business characteristics, that include name, address, postcode, standard industrial classification, employment and employees, turnover, enterprise group links, and the turnover generated by new products, the survey only permits us to classify firms into innovators and non-innovators and asks

[28] Please see Wooldridge, J. (2002) on derivation of the instrumented systems of equations and the instrumented techniques.
[29] For more information on CIS and what these datasets contain see: http://nswebcopy/StatBase/Source.asp?vlnk=926&More=Y

about types of aggregate innovative expenditures. It allows that firms produce the amount of expenditure in each innovation activity (Intramural and extramural R&D, Acquisition of external knowledge, Training, All forms of design, marketing expenditure, etc.) in a monetary value (£000s).

ONS surveys tend to account for the majority of large sized businesses (for these have a greater economic impact), and then select a number of small and medium sized businesses sampled by industry and geographical region. To date there have been 4 CIS Surveys taken place with the latest in 2009. Despite some survey questions were changed and more detailed we will be using CIS4-6 panel data component released recently by ONS (September 2011) for our analysis. This ensures consistency of econometric estimation and allows controlling for existing heterogeneity across UK firms within 2002-2009.

Briefly we are describing three of the following survey included in the panel. CIS 4 covers the period 2002-2004. It consists of 4049 successfully matched firms with CIS5-6 and BSD from 16240 firms originally available from ONS (24.93% matched). The CIS 5 survey was undertaken in 2004-2006 and consists of the same 4049 matched firms within CIS4 -6 and BSD from about 14000 originally available on CIS5 survey (28.92% matched). The version of CIS/BSD matched data used for the paper covers the year 1998-2006. CIS was originally conducted every four years, but since 2005 has been conducted every two. The UK Innovation Survey 2009, the sixth Europe-wide CIS was sent to 28,000 UK enterprises with 10 or more employees and achieved a 50 per cent response rate.

The Top 5 sectors presented in CIS4-6 panel data include: 74 – Other business activities including patents, financial management and consulting (1939 firms); Construction (959 firms); Retail trade, except of motor vehicles and motorcycles (895 firms); Wholesale trade and commission trade, except of motor vehicles and motorcycles (819 firms); Hotels and restaurants (659 firms).

For a detailed Top 5 sector split by each CIS round please see Table 3.2 below. One may easily notice a shift towards service sector (Hotels and restaurants), real estate and manufacturing during the economically constrained times; from the traditional business activities, construction and trade.

Table 3.2: Top 5 sectors included in the CIS4-6 panel dataset (CIS split)

CIS4-6 Panel	
SIC 92 sector	Number of reporting. Units
Other business activities	1939
Construction	959
Wholesale trade and commission trade, except of motor vehicles and motorcycles	895
Wholesale trade and commission trade, except of motor vehicles and motorcycles	819
Hotels and restaurants	659

Regarding the size of the reporting units split within CIS4-6, share of small businesses varies from 47.6 to 50.4%. The other half of the companies is shared almost equally between large and medium companies with a share of medium businesses from 24.6 to 26.4% and a share of large businesses within 24.9 and 26.0%. Table 3.3 shows the split between the sizes of the companies across each CIS round.

Table 3.3: Firm size composition by CIS

Size of Enterprise	CIS4		CIS5		CIS6	
	Number of reporting. Units	%	Number of reporting. Units	%	Number of reporting. Units	%
Small - 10-49 employees	2040	50.38	1989	49.12	1927	47.59
Medium - 50-249 employees	999	24.67	1018	25.14	1068	26.38
Large - 250+ employees	1010	24.94	1042	25.73	1054	26.03
Total	4049	100	4049	100	4049	100

Table 3.4 below shows the list of variables used in the analysis, sources and the way they were constructed. Table 3.5 shows the descriptive statistics of the variables and Table 3.6 reports the correlation matrix of the variables used in the analysis.

Table 3.4: Variables used in the study

	Variable name	Source of the data	Measure description and construction
Dependent variables	New product revenue (NPR) in £000	CIS 4-6 (q810, q2420)	NPR is obtained by multiplying firm's share of products introduced that were new to firm's market by the firm's turnover. Measure included was ln(1+NPR)
	NPR per employee	CIS 4-6 (q810, q2420, q2520)	NPR divided by the number of listed employees in £000. Measure is reported as (1+NPR) / q2520 taken in logs
Endogenous variable	Training (T)	CIS 4-6 (q1450)	Training expenditure is company-financed training unit expenditures in £000. We transform measure in ln(1+T)
	Rivals	BSD (2002-2009)	Number of rivals in the industry calculated by 2 digit SIC (92) sector taken in logs
	Global	CIS 4-6 (q230, q240)	Dummy variable=1 if the enterprise sells goods and/or services overseas (Other Europe and all other countries except the UK).
	Public	BSD (2002-2009)	Dummy variable=1 if the enterprise is a publicly traded company.
	Foreign	BSD (2002-2009)	Dummy variable=1 if the parent firm is located abroad (USA or other).
	Cooperation	CIS 4-6 (q1861, q1862, q1871, q1872)	Dummy variable=1 if the co-operation partner (e.g. Universities or other higher education institutions; Government or public research institutes) is located locally/ regionally within the UK or a partner is a UK national. Reporting unit level
	Patents	CIS 4-6 (q2130)	Dummy variable=1 if the unit used patents to protect its innovation; zero – if patent protection has not been used. Data is unavailable for CIS6 due to changes in reporting the survey question. Reporting unit level
	Scientists (S)	CIS 4-6 (q2610, q2520)	Number of employees educated to degree level in science and engineering. Measure included was ln(1+S)
	Small firm	CIS 4-6 (q2520)	Dummy variable=1 if the unit's number of employees less or equal 50; zero – otherwise. Reporting unit level
	Large firm	CIS 4-6 (q2520)	Dummy variable=1 if the unit's number of employees more or equal 250; zero – otherwise. Reporting unit level

	Biotech and pharmaceutical	CIS 4- 6 (SIC92, SIC2003)	Dummy variable=1 if the if 3 digit SIC(92) is sic244 or/ and sic241 or/and sic247; zero otherwise
	Computers & electronic equipment	CIS 4- 6 (SIC92, SIC2003)	Dummy variable=1 if the if 3 digit SIC(92) is sic721 or/ and sic723 or/ and sic724 or/and sic300 or/ and sic722; zero otherwise
	Machinery	CIS 4- 6 (SIC92, SIC2003)	Dummy variable=1 if the if 3 digit SIC(92) is sic343 or/ and sic292 or/ and sic295 or/and sic341 or/and sic353 or/and sic296 or/and sic291; zero otherwise
	Instruments	CIS 4- 6 (SIC92, SIC2003)	Dummy variable=1 if the if 3 digit SIC(92) is sic294 or/and sic332 or/and sic333 or/and sic334; zero otherwise
	Transportation	CIS 4- 6 (SIC92, SIC2003)	Dummy variable=1 if the if 3 digit SIC(92) is sic602 or/and sic601 or/and sic603 or/and sic611 or/and sic621 or/and sic623; zero otherwise
	Medical instruments	CIS 4- 6 (SIC92, SIC2003)	Dummy variable=1 if the if 3 digit SIC(92) sic331
Instruments for Training expenditures	Firm's capacity	CIS4-6 (q1250)	Reported the importance of increased capacity for production or service provision for the product (good or service) and/or process innovations. Four mutually exclusive responses (0 - Not used; 1-Low; 2 - Medium; 3 - High).
	Market info	CIS4-6 (q1907)	Reported the importance to enterprise the lack of information on markets as a factor which constraints innovation activities. Four mutually exclusive responses (0 - Not used; 1-Low; 2 - Medium; 3 - High).

Source: Office of National Statistics UK

Table 3.5: Descriptive statistics

Variable	CIS4 (2002-2004)			CIS5 (2004-2006)			CIS6 (2007-2009)			Panel CIS4-6 (2002-2009)		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
NPR	4049	1.51	3.90	4049	1.20	3.53	4049	1.12	3.41	12147	1.28	3.61
NPR per employee	3668	0.98	2.44	3763	0.76	2.17	3521	0.78	2.21	10805	0.77	2.20
Rivals	4049	6.19	0.97	4049	6.19	0.96	4049	6.20	0.95	12147	6.19	0.95
Global	4049	0.19	0.40	4049	0.20	0.40	4049	0.19	0.39	12147	0.19	0.39
Public	4049	0.88	0.32	4049	0.88	0.32	4049	0.88	0.32	12147	0.88	0.32
Foreign	4049	0.13	0.33	4049	0.13	0.33	4049	0.13	0.33	12147	0.12	0.33
Cooperation	4049	0.06	0.23	4049	0.04	0.21	4049	0.07	0.26	12147	0.05	0.23
Patents	3942	0.21	0.41	3662	0.24	0.43	4049	.	.	11653	0.22	0.42
Scientists	4049	2.38	3.28	4049	2.44	3.31	4049	2.27	3.24	12147	2.36	3.28
Small firms	4049	0.50	0.50	4049	0.49	0.50	4049	0.48	0.50	12147	0.49	0.50
Large firms	4049	0.25	0.43	4049	0.26	0.44	4049	0.26	0.44	12147	0.26	0.44
Biotech and pharmaceutical	4049	0.00	0.07	4049	0.00	0.07	4049	0.01	0.08	12147	0.01	0.07
Computers & electronic equipment	4049	0.02	0.14	4049	0.02	0.14	4049	0.02	0.14	12147	0.02	0.14
Machinery	4049	0.04	0.19	4049	0.04	0.19	4049	0.04	0.20	12147	0.04	0.19
Instruments	4049	0.01	0.10	4049	0.01	0.11	4049	0.01	0.11	12147	0.01	0.11
Transportation	4049	0.06	0.23	4049	0.06	0.23	4049	0.06	0.23	12147	0.06	0.23
Medical instruments	4049	0.00	0.06	4049	0.00	0.05	4049	0.00	0.06	12147	0.00	0.06
Firm's capacity	3566	0.94	1.14	3881	0.42	0.92	3750	0.67	1.05	11197	0.68	1.04
Market info	2102	1.34	0.66	1805	1.17	0.76	2283	1.18	0.73	6190	1.23	0.72
Training	4049	0.90	1.50	4049	0.77	1.38	4049	0.41	1.07	12147	0.70	1.35
Training (total)*	4049	23.09	171.80	4049	27.49	797.14	4049	23.27	799.73	12147	24.62	659.37

*Training expenditure is taken in levels , 000s £

Source: Office of National Statistics UK.

Table 3.6: Correlation matrix

	NPR	NPR per employee*	Training	Rivals	Global	Public	Foreign	Cooperation	Patents	Scientists	Small firms	Large firms	Firm's capability
NPR per Employee	0.98*	1											
Training	0.23*	0.20*	1										
Rivals	-0.12*	-0.13*	-0.03*	1									
Global	0.22*	0.20*	0.15*	-0.21*	1								
Public	0.08*	0.07*	0.07*	-0.15*	0.11*	1							
Foreign	0.08*	0.07*	0.13*	-0.15*	0.20*	0.13*	1						
Cooperation	0.25*	0.24*	0.20*	-0.10*	0.19*	0.03*	0.08*	1					
Patents	0.24*	0.22*	0.22*	-0.13*	0.23*	0.10*	0.16*	0.13*	1				
Scientists	0.25*	0.20*	0.31*	-0.13*	0.31*	0.15*	0.25*	0.21*	0.24*	1			
Small firms	-0.05*	-0.01	-0.20*	-0.08*	-0.12*	-0.17*	-0.24*	-0.06*	-0.11*	-0.29*	1		
Large firms	0.06*	0.02*	0.21*	0.09*	0.06*	0.14*	0.27*	0.06*	0.11*	0.26*	-0.57*	1	
Firm's capability	0.37*	0.36*	0.33*	-0.11*	0.21*	0.10*	0.09*	0.27*	0.18*	0.26*	-0.10*	0.09*	1
Market info	0.13*	0.06*	0.14*	-0.04*	0.15*	0.03*	-0.02*	0.10*	0.12*	0.16*	0.03*	-0.05*	0.22*

Source: Office of National Statistics UK

Note: The variable NPR per employee as a proxy for the productivity of a new products / processes will not be used interchangeably with the level of innovation in our analysis given the correlation coefficient between the NPR and NPR per employee is approaching the unity. Moreover the sign of the relationship with the other independent variables is same. Additionally the confidence intervals of both variables are overlapping. Wald test on the equality of the correlation coefficients between the NPR and NPR per employee with the independent variables was not rejected at 1% significance level. This could also be seen by a simple eyeball test comparing the pairwise correlation coefficients in column 1 and column 2 of the Table. The results of the tests and regressions using both NPR and NPR per employee are available from authors upon request.

3.4. Results

The results of the analysis are shown in Tables C1-C3 in Appendix A. The equation 1.10 explains the impact of holding a patent and of training expenditure on NPR, while the first stage equation 1.9 of 2SLS and IV Tobit estimates the incentives offered for training expenditure due to holding of a patent and other factors. Both H1 and H2 are supported by the estimation results. H3 is rejected. Table C1-C3 shows the estimation results (1.9-1.10) with NPR (in 000s £) taken in logarithms as a dependent variable, separately for the three cross-sections of CIS4, CIS5, CIS6.

3.4.4. New product revenue and returns to patenting

Our returns to patenting measure $\delta = B_2+1$ means that, as a firm gets a patent, NPR increases by 1+1.64=2.64 for CIS4 and by 1+0.59=1.59 for CIS5 (Table C1). The results from the panel data estimation using instruments are even more precise and are restricted in the interval between 1.92 and 2.01 (see Table C2). Although our finding is consistent with the estimates by Arora et al. (2011) for the UK firms assumed that the patent propensity is 1/3, the method of obtaining these results is different. Arora et al. (2011) calculate the patent premium on the UK innovators during the period 1997-2006 which is overlapping with our data except for the use of cross-section estimation which does not allow them to control for existing unobserved heterogeneity across firms. Moreover, their study assumes certain level of patent propensity from 1/3 to 2/3 which means that from 1/3 to 2/3 of all innovations developed have been patented.

The patent premium to NPR is derived from the marginal effect of patent effectiveness on NPR (viz. importance of patents as an instrument of IP protection by managers) given a certain assumed patent propensity of the firm. On the contrary, in our case the patent propensity for the firm is given: it is either one or zero, depending on the fact of holding of a patent. Our case falls in the extremes of Arora et al. (2008, 2011) assumptions about patent propensity (which is in the range from 0 to1) using a dummy variable for patent propensity viz. is exactly whether the reporting unit does (patent propensity equals zero) or does not (patent propensity equals one) use patent as an instrument of IP protection. Our results enable us to choose from the range of assumed patent premia offered by Arora et al (2001) calculated on the basis of different assumptions on patent propensity; those that overlap with the range 1.92-2.01 are the patent propensity of 1/3 or less. These estimates of patent propensity are also similar to those in the US manufacturing sector calculated by Arora et. al (2008). This means that the UK innovators patent a third or less of their innovations, which can also be seen from the descriptive statistics - the mean of 'holding a patent' dummy. The UK innovators may choose to use other methods of protection for the rest of innovation like secrecy, speed and others being unaware that indeed patenting ensures up to 200% higher returns on their innovation.

We split the sample into two in the Table C3. One sample to which the instruments are applied consists of 520 young firms called "start-ups" (<11 years) and 4824 mature firms (>10 years). We estimate patent premium which is positive both for young (2.86) and mature firms (1.87) and significant for both types. These results suggest that holding a patent increases NPR of a young firms on average by 286% and mature firms by 187% (depending upon which CIS round we use for coefficient values). This finding is in line with Rosenbusch et. al. (2011) who emphasized that innovation has a stronger impact in younger firms than in more established SMEs. This finding suggests that the often cited liability of newness of younger firms can also be an asset for new firms. Their finding indicates that new firms possess unique capabilities to create and appropriate value through innovations.

Higher returns to patenting may discourage young firms from investment in innovative training and education, if they are able to restrict the access of competitors and significantly increase their innovative outcomes by holding a patent. Holding a patent indeed could become a substitute for investment in innovative training and education, which eventually may affect the young company in a longer run. This is a message to policy makers and young (start-ups) company managers.

3.4.5. New product revenue and returns to training

Estimating the implied increment to new product revenue due to higher expenditure on training an education we can speak about the marginal effect on NPR of innovative training and education expenditure. Existing estimates of training premium reported in the literature typically relate to increment to operating profits (also, value added, scrap rates, etc. – please refer to Table 3.1) rather than to the increments to new product revenues. Put differently, this estimate combines both the direct effect and indirect effects from training expenditure on NPR analogically to returns to patenting (see e.g. Holzer et al., 1993; Kammerer, 2009).

We find that the elasticity of the new product revenue with respect to training expenditure is within the range of 0.3 – 0.5 % for the OLS estimates, in the range of 3-5 % for the 2SLS estimates, and varies from 15 to 36 % for the Tobit estimates for different waves of the CIS.

When we estimate the same equations on the panel data, the corresponding elasticity of NPR to training expenditure is 0.25-0.32 % for the linear panel data non-instrumented regressions (Pooled OLS, random and fixed effects, maximum-likelihood estimation), and 3.2-5.0 % for the instrumented estimations. Thus, we note that our results (excluding Tobit results, where we do not perform the equivalent estimation on the panel data) are very robust and consistent both across cross-sections and the panel.

The elasticity is the lowest for the CIS4, and is the highest during the economically constrained times 2007-2009 sample – the data from CIS6 survey. The potential explanation is linked with the impact of economic crisis, in a way the companies starting from the same level of training will intend to achieve higher returns to their input in various ways: improving the quality of services provided, putting additional pressure on workers, cutting other input costs, etc. Workers during the credit crunch years are often expected to put in more effort for the same or even lower compensation, and may be afraid of layoffs which may increase their productivity. Furthermore a consistently growing demand for new products given the lower level of inputs (including training expenditure) is going increase the returns to training in terms of NPR. So, given same level of inputs (innovative training and education in our case) a company would attempt to achieve higher results during the economically constrained times and more competitive external environment which will drive up returns to inputs.

A good case study example of an increase in labor market pressure could be a chain of the supermarkets in the UK called Aldi. From the interview with the Aldi HR and skills team managers we came to know that Aldi paid their sales manager £8 per hour before the crisis hit them and now they get a 2 months waiting list for the same post given the salary is now down to £6 per hour. Speculating, Aldi could consider minimizing the cost of innovative training hiring already trained personnel and, expecting them to work harder or at least do the same job under the pressure of being on the job market again.

At the same time, the demand for innovative products in the UK may keep growing along with the basic products (technological gadgets could be an example here). In fact we expect the demand for innovative products to increase overtime, which also explains higher revenue on new products generated by innovative firm overtime including the data from the economically constrained time (2007-2009). This explanation is consistent with the results obtained in Table C2 for the panel data estimates, when the Year dummy for CIS6 is positive and significant.

When splitting a sample into two in the Table C3 we find that the difference in training premium between the start-ups and mature firms is respectively 2.8 and 3.3%. This result is obtained using EC2SLS RE (Baltagi's EC2SLS random-effects estimator) described in Baltagi (2008) which has proved to fit better the estimated model. A Likelihood-ratio test of Sigma u=0 rejected at 1% level in favour of random effects and the F-test of all u_i=0 both confirm the presence of random effects in the model. Although we are not using Tobit estimation in panel data analysis, the consistency between the 2SLS estimations in Tables C1 and C2 are obvious. We are not attempting to calculate the training

premium for start-ups and mature companies separately, although we can conclude that there are significant and positive returns, which are about 15-20% higher for the mature firms (>10 years).

3.4.3. The implied elasticity of training to patent protection

The most interesting finding linked to managerial policy is related to estimating the effect of patent protection in inducing more training and education expenditure. Equation (1.9) by incrementing training expenditures enables to compute the implied elasticity of training to patent protection (E_T). Because this is a log-linear computation the direct effect can be read from the coefficient alone (multiplied by 100%).

What would happen with training expenditure if a company chooses to protect its innovation by patenting and why? Table C1 (first stage results) show that holding a patent does not imply more investment in training. This effect does not change across the CIS4 and CIS5 for the same companies. The result goes contrary to the perception of patents and training being complements.

Comparing both returns on patenting and training, one could understand that the returns to patenting overwhelmingly overweight the returns to training with 200% returns on patenting vs. at a maximum 36% returns on innovative training. Although we are not claiming that the investment in training and education is not important, it is definitely not a first priority for those companies who are able to extract higher benefits on innovative sales once they hold a patent. Patent premia earned on innovation protection disincentivise or have zero-effect on additional training expenditure for the firms that have higher patent propensity. On the contrary, those companies with a lower patent propensity are constrained to spend more on the other forms of formal protection such as registration of design, confidentiality agreements, copyright as well as informal protection such as secrecy, lead-time advantage on competitors, complexity design, information on markets. In order to be able to introduce these methods of innovation protection, the firm will spend more on training and education of its personnel as well as will employ more staff with science and engineering degrees. Existence of other forms of innovation protection will drive knowledge investment in training out of those markets were the protection has already been granted. Therefore, we reject H3 and do not find any relationship of the impact of patenting on investment in innovative training. This effect has not been estimated on the split sample – young vs. mature firms, which should become a subject for the future research.

3.4.4. New product revenue, training expenditure and their drivers

The results for the instrumenting of innovative training expenditure (first stage estimates) presented in Table C1 on page 24, give us an idea of the importance of various drivers of training for innovative training expenditure. Mostly of the included controls are significant in at least two waves of the CIS data. Consistent with most of the literature (see, e.g., Baldwin and Johnson, 1995, for Canada; Korber and Muravyev, 2008, for Ukraine) relating training and firm size, we find that small firms' training expenditure is 19-39% less than that of the medium-sized firms, while for the large firms it is 13-58% higher, for different waves of the data; (however, cf. Hansson (2007) who in a sample of 26 countries did not find any effect of firm size on either training as percent of wage bill, or on the share of employees trained). The number of competitors has a positive impact on training expenditure, which suggests that the firms may use their training policy as a strategy against their industry rivals. Interestingly, cooperation between the firm and the university/research institute has a strong positive impact on training, the presence of such increasing training expenditure by 46-61%. Global scope of operations (exporting activities) is found to be negatively related to training, however, this result is only significant for the CIS4. The share of degree-educated scientists among the firm's employees is positive and significant consistently across all three waves, with 1% increase in the number of scientists leading to a 1% in the innovative training expenditure. Ours is the first study that employs this variable as a driver of training (as opposed to the share of worker with higher education in general). Ownership type (public or foreign-owned) is not significantly related to innovative

training, which is in contrast to, e.g., Korber and Muravyev (2008) who find that state ownership has a positive effect on training.

With regards to the variation of innovative training expenditure by industry, we find that training expenditure tends to be 45-53% higher in the computer & electronic equipment industry, 40-61% higher in the production of instruments, and 30% in transportation industry, but the latter result is obtained for CIS4 data only. (Dumbrell (2002) analyses expenditure on training in Australia firms, however, our results are not directly comparable as he uses a different industry classification).

Finally, our first instrument viz. firm "Reported the importance of increased capacity for production or service provision for the product (good or service) and/or process innovations. Four mutually exclusive responses (0 - Not used; 1-Low; 2 - Medium; 3 - High)", increases training expenditure by 16-31% for a unit increase in the indicator and is significant for all three waves of data.

The second instrument viz. firm "Reported the importance to enterprise the lack of information on markets as a factor which constraints innovation activities. Four mutually exclusive responses (0 - Not used; 1-Low; 2 - Medium; 3 - High)", has a positive 5% effect on training expenditure for a unit increase in the indicator, although only in CIS6. As pointed out in Section 3.4.3, patent adoption is not found to have any significant effect on the innovative training expenditure.

3.4.6. Discussion

Our study develops the methodology (a model) and quantifies additional revenue coming from sales of the new products due to investment in innovative training by the firm and the fact that a firm holds a patent to protect its innovation. The result is estimated for the UK innovative companies and can the model could be easily applied for the other micro-level studies using various proxy for innovative outcomes and knowledge expenditure. This is our contribution to literature on returns to patenting and training.

Our estimates show that the returns on investment in innovative training are generally lower than those found in the previous studies researching on the impact of training on the firm's performance (Bartel, 2000). The results obtained with instrumented panel data technique establish the returns to training are on average about 3.7-3.8% overall and 2.8% for start-ups and 3.3% for mature firms over the period 2002-2009. More sophisticated Tobit estimation quantifies the returns on training is between 15 and 36% over the period 2002-2009 using cross-section technique. Moreover, since we measure the returns to innovative training using NPR, which includes only the increase in the company's innovative outcomes; we cannot expect them to be as high as the corresponding return to training using other more general measures (total sales, overall labour productivity, value added).

Using both cross-section and panel data estimation we show that there are positive returns to training and patenting in terms of new product sales. In addition, this study enables to achieve more precise measures of ROI, as a follow up to the previous studies. Panel data estimation enables us to control both for fixed and random effects and justify the results obtained using cross section analyses for three periods (CIS4-6). The only exception of Cassidy et al. (2005) research on returns to training is cross-sectional with noise coming from previous periods and potentially effecting innovative outcomes. As noted before, we instrument training which has proven to be endogenous in our model. This ensures us an improvement in efficiency; thus, while a number of previous studies failed to find a significant link between training and performance, since they did not use instrumenting, this could explain such an outcome. On the contrary, our results are robust and significant across all three cross-sections, and in the panel data with fixed and random effects.

Our estimates on the patent premium are within 159-264% for CIS4 and CIS5 (Table C1), however more precise estimate using panel data narrow down this interval to 192-201% (see Table C2). Although this finding is consistent with the estimates by Arora et al. (2011) which assumed 1/3 patent propensity, the other estimates are considerably lower. Consequently, the method of obtaining these results is different and the interval for patent propensity that we infer from our estimates is a lot narrower. According Arora et al. (2011) findings we could speak about the propensity to patent for the UK innovators which overall is a third of less. This result is also consistent with the descriptive statistics of a patent dummy mean, which indicates that only 22-24% of the reporting units protect

their innovation by patents. This result is based on the interval obtained using panel data estimation with instruments for our endogenous variable and it overlaps with Arora et al. (2011) patent premium given the patent propensity is 1/3 or less for the same interval (CIS4-CIS5). There is no special study by Intellectual Patent Office UK which analyses a patent propensity of the UK innovators as the study carried out by Arora et al. (2008) on the US manufacturing companies. A survey on the patent propensity is calling, and until that time 1/3 patent propensity for the UK innovation could be accepted as a threshold. This means that the UK innovators patent only a third of their innovations and use other methods of protection for the rest of innovation like secrecy, lead-time advantage on competitors, complexity design, market information, etc. Patent premia are positive for both young and mature firms although we always expect higher premia from the young companies that can benefit more from the patent protection.

Dealing with endogeneity of training expenditure in a system of equations (1.9-1.10) allowed us to estimate the main determinants of training as well as to test H3 on the positive increments of patent protection to the investment in knowledge (training and education). Rejecting H3 in the Table C1 has an important interpretation first of all for policy makers and government agencies. Department of Business, Innovation and Skills of the UK government and Intellectual Patent Office UK may be interested in the result that there is not going to be any increase in knowledge expenditure for the firm, once the patent protection is in force. In fact government agencies interested in stimulating training and education expenditure by the UK innovators should encourage inventors to consider other instruments than patents and not to rely on high knowledge intensity of the UK business once the patent is issued. Legal protection by patents neither encourages nor discourages knowledge expenditure. We would like to advise the policy makers to initiate projects that encourage cooperation between the firms and Universities or other higher educational institutions as well as the Government or public research institutes located locally/ regionally within the UK. This recommendation could be developed from the results of the estimation in Table C1 (first stage). Additionally, helping companies to recruit and educate potential employees holding a degree level in science and engineering will not only push up the knowledge expenditure, but will also increase the innovative outcomes. Both of the policy instruments could be considered a main priority while developing skills and innovation policies for the UK active innovation performers.

Finally, lower returns to training compared to returns on patenting overall and for a young companies and start-ups (<10 years) will call for policies looking to motivate managers and shareholders of the companies to change their approach to training and educational programmes. Higher returns on patenting and lower returns on training for a start-ups and young companies should draw attention of the government agencies. If there is no link between patent protection and knowledge expenditure, small businesses could be benefiting more by restricting market access to their competitors via patents and will automatically maximize their profits by cutting other inputs costs, including innovative training and education.

In order to keep up with the modern challenges in innovation this paper calls to formulate efficient policy on intellectual property rights protection and knowledge investment on the basis of the results obtained in the study. As such, information on the patent propensity of the UK firms could be useful in developing the measures that increase this propensity. Not surprisingly patent protection makes a lot of sense to the firms as it increases the NPR by at least 191%, which seems a promising number both for IPO and for new patent applicants. Further research may focus on estimating returns to patenting and training by industry (2 or 3 digit SIC) and for non-for-profit units, like the UK based social and green entrepreneurs. Same estimations could also be done by the six aggregated industrial sectors used as controls in the model and for different levels of eco-innovation effectiveness. The relevant questions could be: "Are the returns to patenting and innovative training different for firms of various sizes, location and industries? Are the returns to patenting higher for green innovators and social entrepreneurs? What is a patent propensity of the UK innovators by industry? firm size and firm age? How the patent propensity may impact final innovative outcomes and firm's innovative performance? Is there a link between patent protection and investment in knowledge expenditure by firm size, firm age, location and the type of industry? This will help formulate policies for providing incentives to invest in more training and education by the firm.

Appendix A: Output Sustainability to Exogenous and Endogenous Shocks: Evidence from Emerging Economies

Data Sources and VAR Estimation and Analysis

Data

The data used in this study are at a monthly frequency and cover the period 2001:M1–2009:M9. The variables are measured as follows:

BAA-AAA is the US corporate bond yield spread calculated as the difference between BAA and AAA Moody's corporate bond yields; LR is calculated as the nominal lending rate on national currency-denominated loans at a monthly rate minus current monthly inflation, measured by the consumer price index; DS is calculated as the difference between the nominal lending rate on national currency denominated loans and the deposit rate on national currency denominated deposits. Same measures of one year nominal lending rate on national currency denominated loans and one year deposit rates on national currency denominated deposits were taken within the countries analysed to ensure cross country consistency; GAP measures deviations of output, y, from trend, y_T. y_T is estimated with one sided moving average, using seven lags. Data were obtained from Datastream, International Monetary Fund (International Financial Statistics), National Bank of Ukraine for Ukraine wired http://www.bank.gov.ua/Statist/sfs.htm and Deutsche Bundesbank for Germany wired http://www.bundesbank.de/statistik/statistik_zeitreihen.en.php; Croatian Central Bureau of Statistics for Croatia available at: http://www.dzs.hr/default_e.htm Federal Reserve bank of St. Louis (Economic Research).

IVAR Estimation

Number of Lags: To determine the number of lags we started by using standard lag-length tests, i.e. Akaike information criteria (AIC), Hannan–Quinn (HQ), and Schwarz. We controlled for residuals autocorrelation functions (cross-correlograms) across the lagged variables looking at the behaviour of residuals within the two standard error bans (taken for 24 lags). The choice of a lag length and the test results are likely to be robust, because of an assumption of covariance stationarity of the considered variables. The number of lags chosen is three.

Panel Unit root test

Table A1. Panel Unit root tests (Summary)*

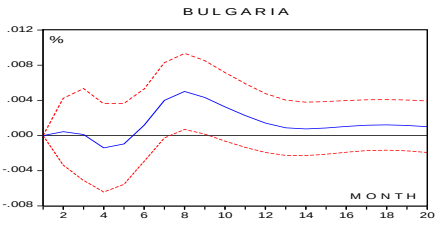
Method	Statistic	Prob.**	Cross-sections***	Number of observations
Levin, Lin & Chu t*	-3.214	0.0007	40	4480
Im, Pesaran and Shin W-stat	-16.516	0.0000	40	4480
ADF - Fisher Chi-square	588.655	0.0000	40	4480
PP - Fisher Chi-square	262.596	0.0000	40	4640

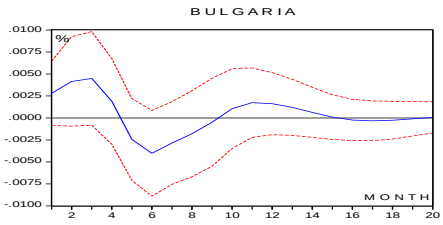
*Automatic lag length selection based on SIC: 0 to 12

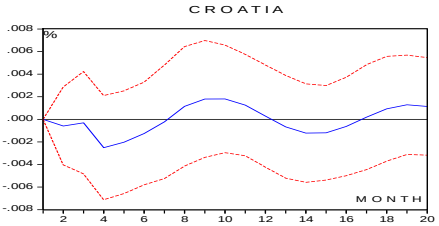
** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality

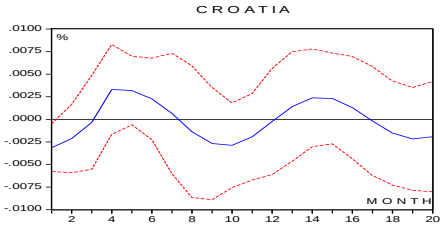
*** Number of cross-sections explains 13 countries and 4 variables included in the model. One variable which is US corporate bond yields spread does not vary across the countries, therefore 3*13+1=40. The output of four Panel Unit root tests in Table A1 allows us to reject the null of a unit root in a panel of 13 transition countries. The process is I(0).

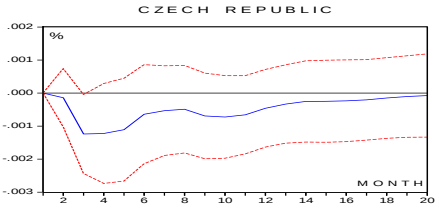
Source: Author's calculations.

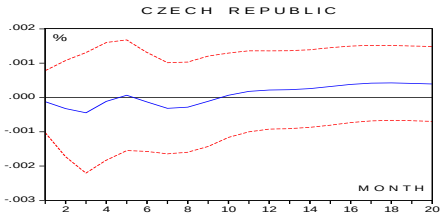

BULGARIA
%
MONTH

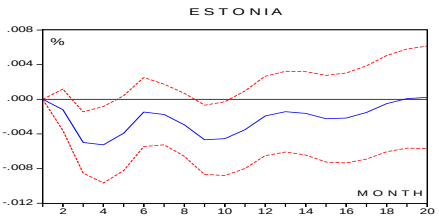

BULGARIA
%
MONTH

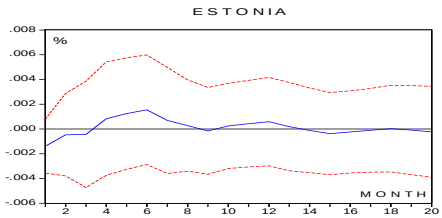

CROATIA
%
MONTH

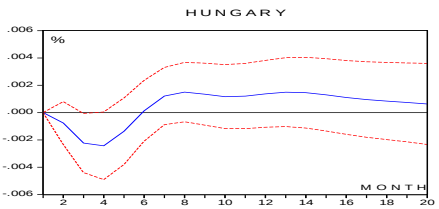

CROATIA
%
MONTH

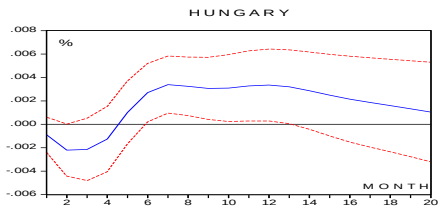

CZECH REPUBLIC
%
MONTH

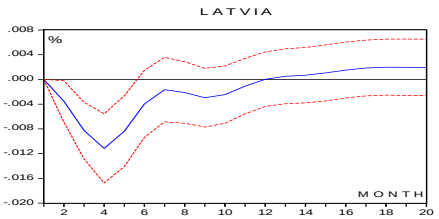

CZECH REPUBLIC
%
MONTH

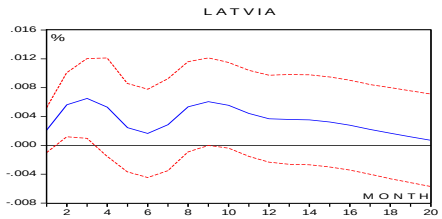

ESTONIA
%
MONTH

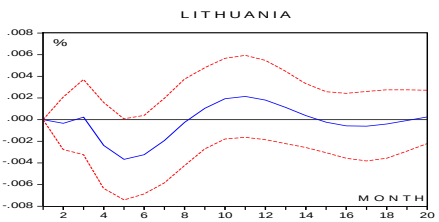

ESTONIA
%
MONTH

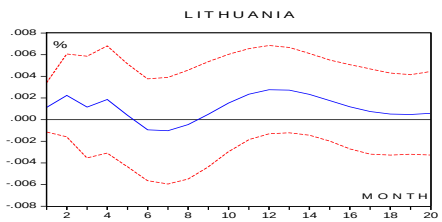

HUNGARY
%
MONTH


HUNGARY
%
MONTH


LATVIA
%
MONTH


LATVIA
%
MONTH


LITHUANIA
%
MONTH


LITHUANIA
%
MONTH

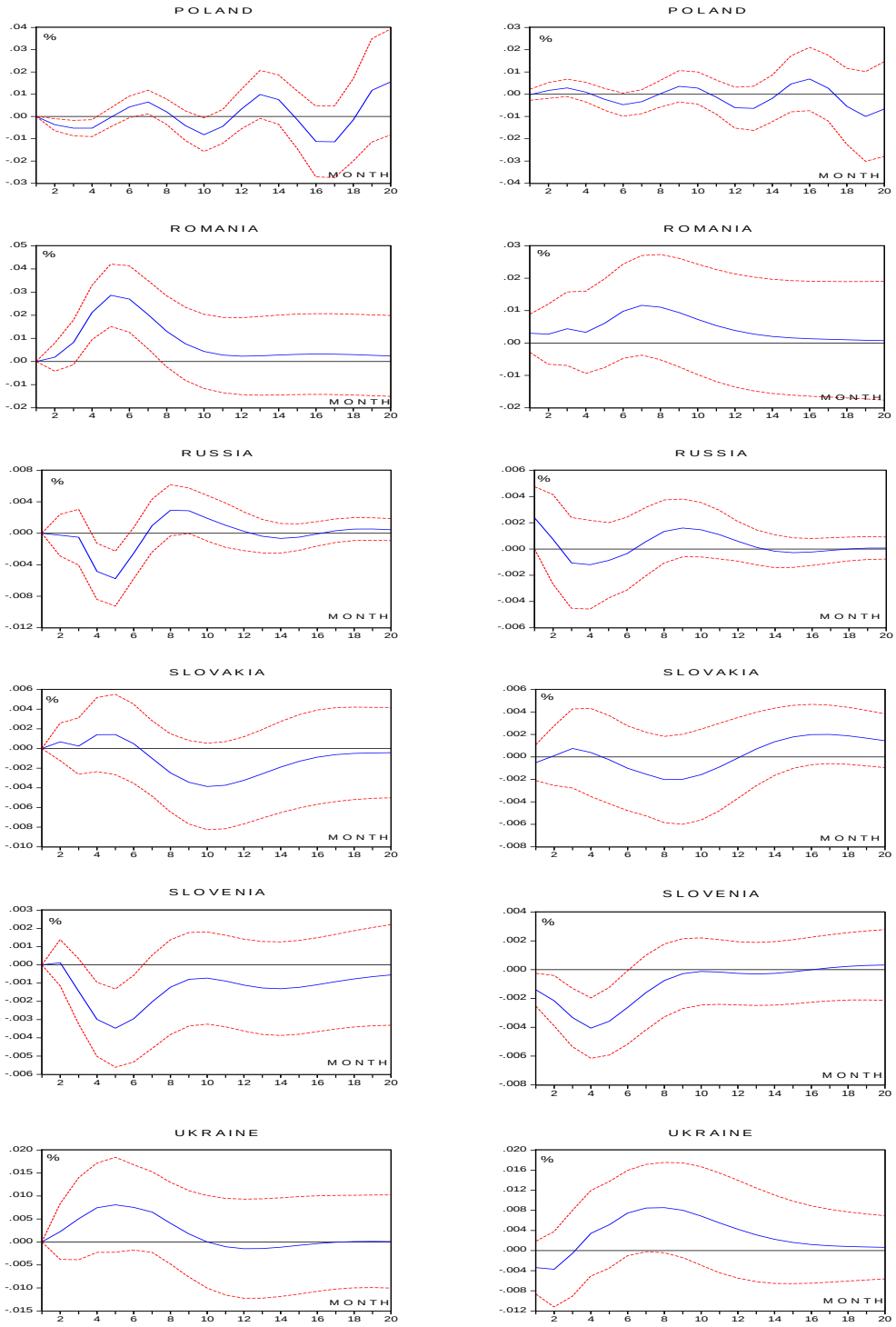


Figure A.1 Generalised Impulse Responses, Output response to historical shock to BAA-AAA (left column) and LR (right column).

Note: The impulse graphs include one-standard-error bands.
Source: Author's calculations.

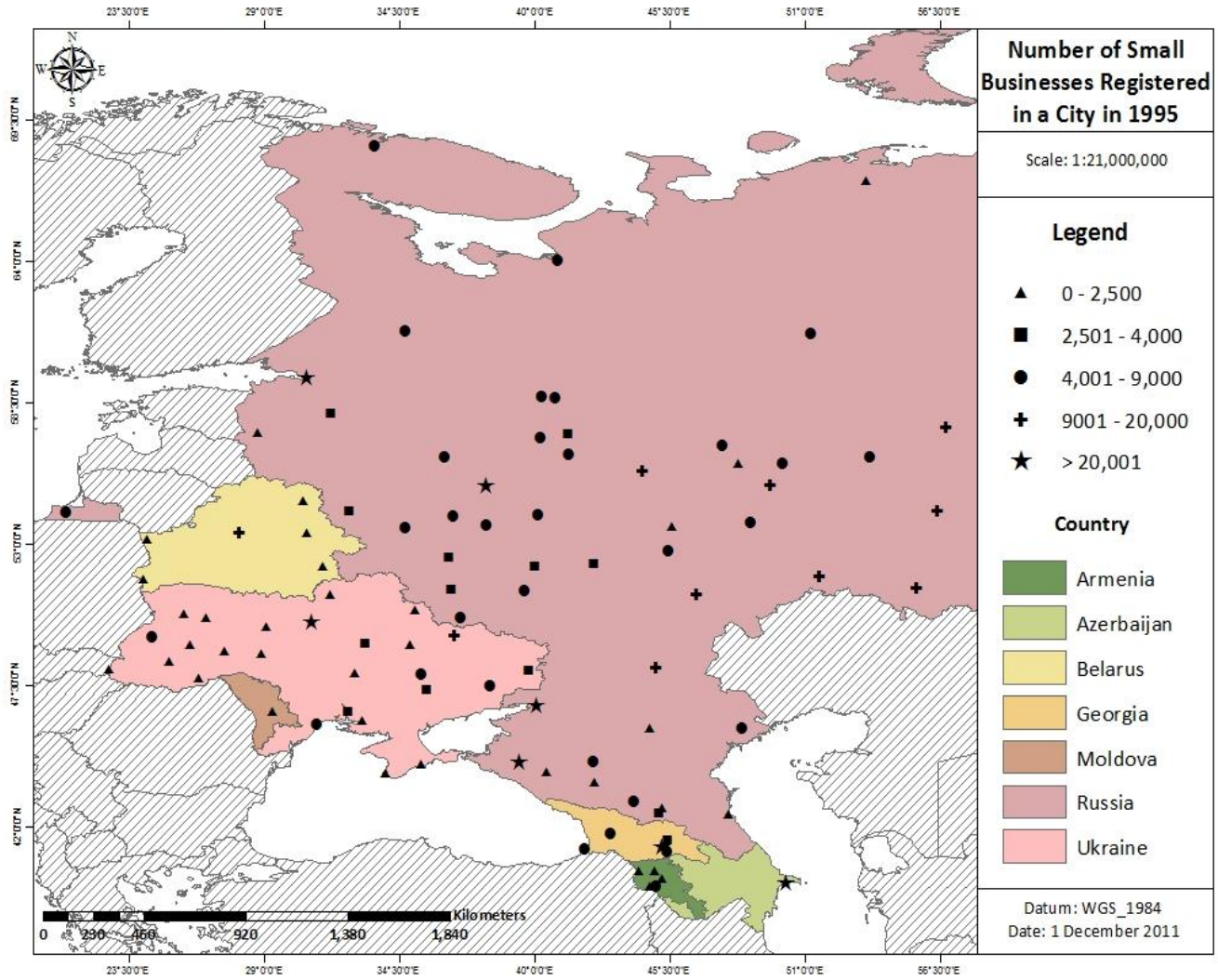


Figure B1: Number of Small Businesses Registered in a City in 1995

Note: Year 2006 is included instead of 2008 for compatibility of cities with the base year 1995. Data on small businesses in 2008 is missing for twenty out of 96 cities.

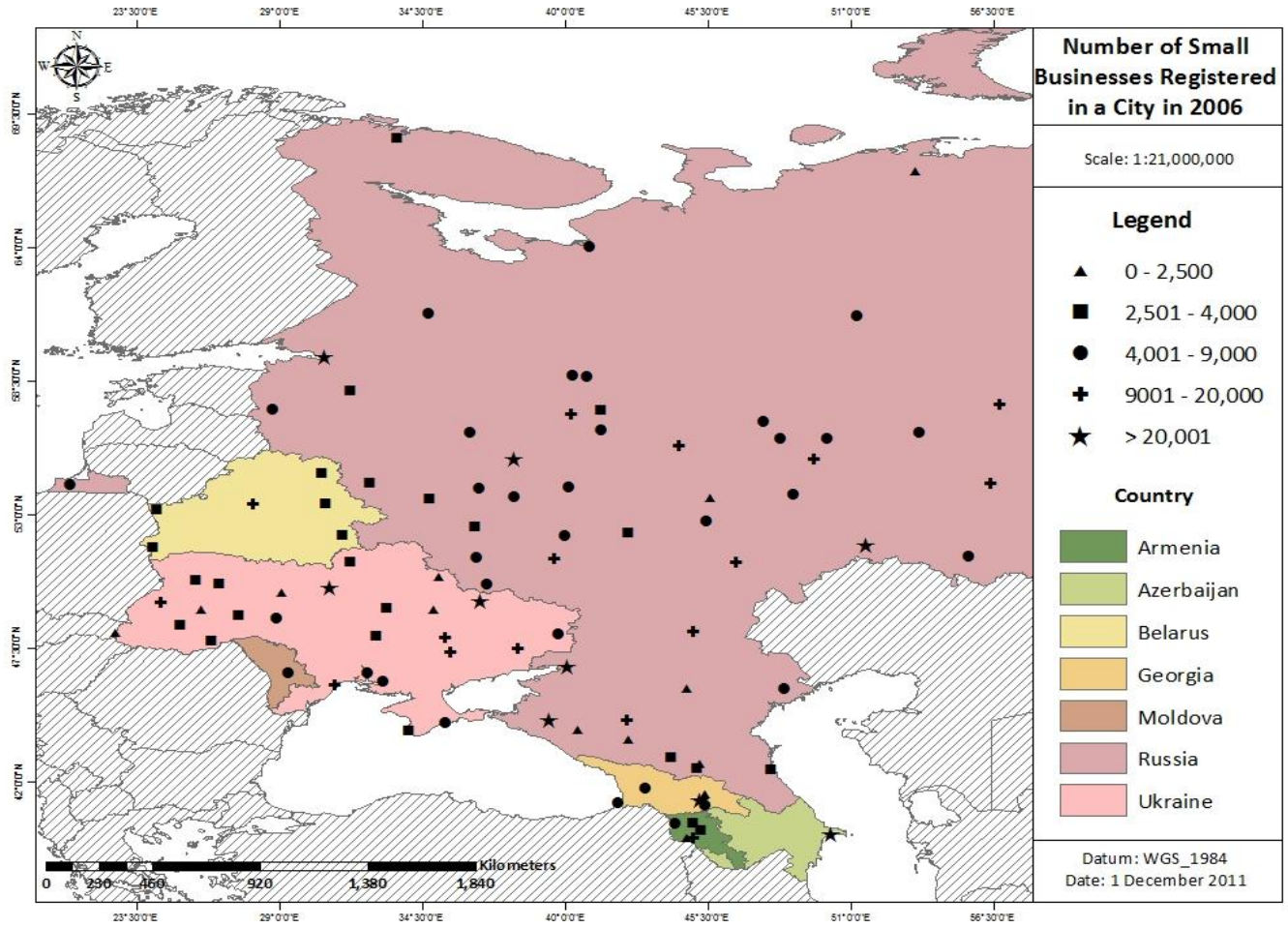


Figure B2: Number of Small Businesses Registered in a City in 2006

Note: Year 2006 is included instead of 2008 for compatibility of cities with the base year 1995. Data on small businesses in 2008 is missing for twenty out of 96 cities.

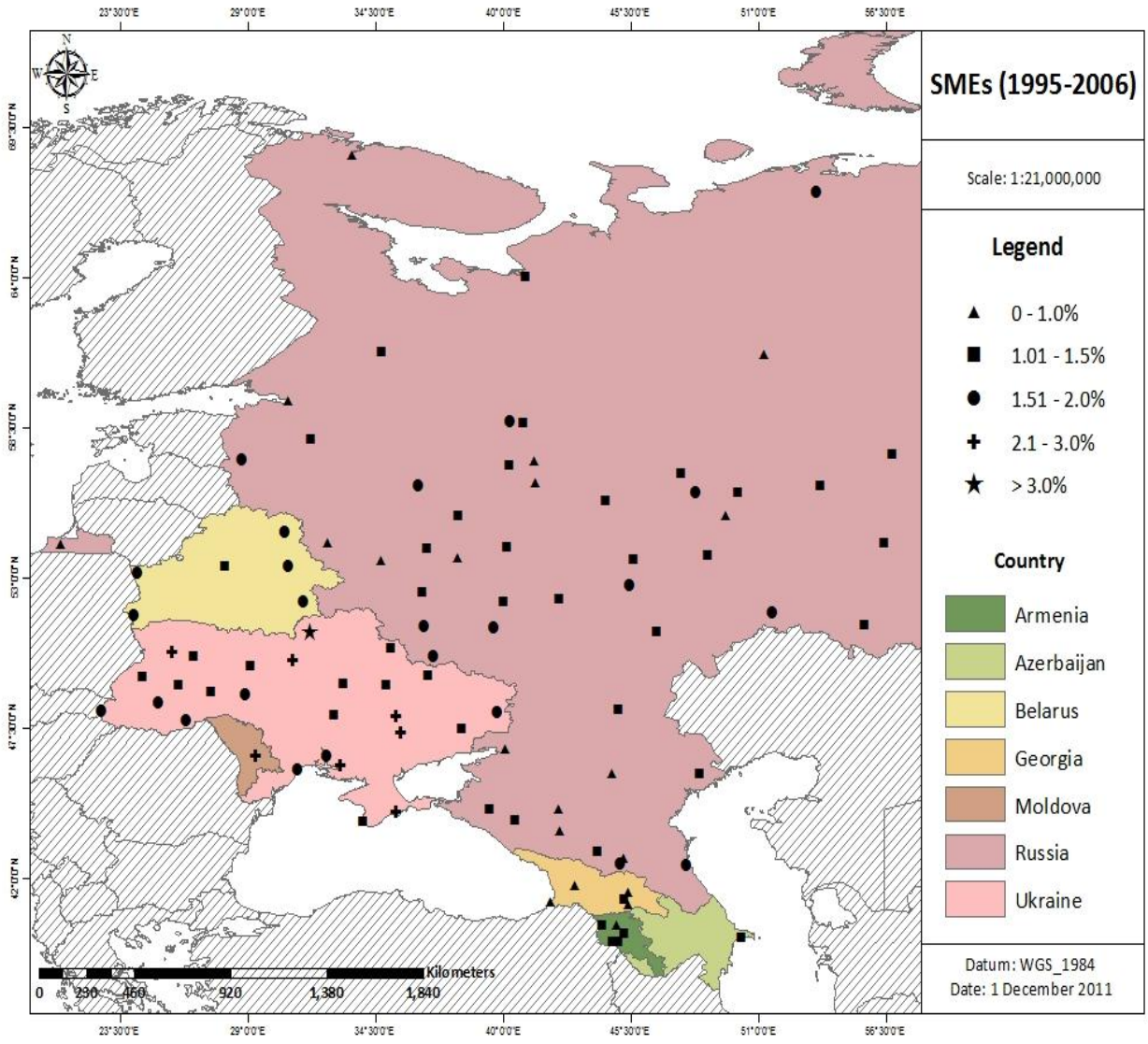


Figure B3: Growth in the number of Small Businesses Registered in a City, 1995-2006

Note: Year 2006 is included instead of 2008 for compatibility of cities with the base year 1995. Data on small businesses in 2008 is missing for twenty out of 96 cities.

Table B1: Descriptive statistics and definitions of the variables

Variable	Definition	Obs.	Mean	St. dev.	Min	Max
SMEs	Number of small and medium-sized businesses registered, logarithm	1160	8.46	1.05	4.09	12.35
SMEs lagged	Number of small and medium-sized businesses registered taken in logs, first lag	1116	8.45	1.05	4.09	12.35
Public expenditure	Public expenditure to GDP ratio	1077	0.59	0.47	0.06	5.73
Capital investment	Capital investment to GDP ratio	987	0.24	0.17	0.01	1.51
University	Number of high educational establishments in a city	1372	7.33	13.26	1.00	103.00
University* Manufacturing/ energy/mining	Interaction: Number of high educational establishments and share Manufacturing/energy/mining sector GDP of a city	1372	91.01	181.85	0.00	1406.5
Population density	Population density in the city per sq. km, Logarithm	1307	7.75	0.58	5.82	9.18
Air pollution	Air pollution, 1000 tons per resident	1148	0.29	0.55	0.00	5.46
Unemployment rate	Unemployment rate - %	1040	3.45	4.08	0.10	30.20
GDP per capita	GDP per capita in constant 2005 USD, millions	1157	7.59	0.77	5.50	11.45
Banking reform	EBRD. Banking reform and interest rate liberalization from 4- to 4+, where 1 represented no progress in reform and 4 major advances	1372	2.17	0.41	1.00	3.00
Executive constraints	Polity IV project. 'Executive constraints' where 1 represented 'unlimited authority'and 7 'executive parity'	1372	4.37	1.11	2.00	7.00
Criminality	Number of crimes per 1000 residents, logarithm	1035	2.68	0.53	0.96	4.06
Freedom of doing business	The Heritage Foundation. The business freedom score between 0 and 100, with 100 equalling the freest business environment	1274	55.82	6.62	40.00	85.00
Manufacturing/ energy/mining	Industry contribution to GDP (%) - Manufacturing, energy & mining	1372	12.81	11.06	0.00	82.74
Agriculture/fishery	Industry contribution to GDP (%) - Agriculture and fishery	1372	22.28	13.92	0.00	81.16
Trade	Industry contribution to GDP (%) - Trade	1372	7.36	4.76	0.00	31.18
Constriction	Industry contribution to GDP (%) - Constriction	1372	12.96	8.82	0.24	62.40
Transport	Industry contribution to GDP (%) - Transport	1372	10.53	3.43	1.23	21.20
Finance	Industry contribution to GDP (%) - Finance	1372	1.11	2.22	0.00	19.70
Education	Industry contribution to GDP (%) - Education	1372	4.16	1.31	0.90	9.80

Source CIS Urban Audit 1995-2008.

Table B2: Correlation matrix for CIS urban audit variables

	SMEs	SMEs lagged	Public expenditure	Capital investment	University	Population density	Air pollution	Unemployment rate	GDP per capita	Banking reform	Executive constraints	Criminality	Freedom of doing business	Manufacturing/energy/ mining	Agriculture/fishery	Trade	Constriction	Transport	Finance
SMEs	1.00																		
SMEs lagged	0.97*	1.00																	
Public expenditure	-0.30*	-0.29*	1.00																
Capital investment	0.03	0.03	0.21*	1.00															
University	0.64*	0.64*	-0.19*	0.00	1.00														
Population density	0.19*	0.19*	-0.35*	-0.09*	0.28*	1.00													
Air pollution	-0.09*	-0.12*	-0.07*	-0.09*	-0.11*	-0.12*	1.00												
Unemployment rate	-0.08*	-0.08*	-0.10*	-0.06*	-0.15*	0.10*	-0.09*	1.00											
GDP per capita	0.18*	0.16*	-0.26*	0.07*	0.24*	0.03	0.40*	-0.25*	1.00										
Bankingreform	0.05	0.05	-0.04	0.10*	-0.01	-0.03	0.00	0.13*	0.35*	1.00									
Executive constraints	-0.04	-0.04	-0.11*	-0.04	0.00	0.05*	-0.02	0.04	-0.09*	0.45*	1.00								
Criminality	0.01	0.01	-0.05	-0.13*	-0.04	-0.26*	0.25*	-0.37*	0.27*	-0.25*	-0.19*	1.00							
Freedom of doing business	0.04	0.06*	0.02	-0.09*	-0.04	-0.07*	0.02	0.30*	0.01	-0.04	-0.12*	0.09*	1.00						
Manufacturing/energy/mining	0.10*	0.08*	0.09*	0.27*	-0.02	-0.03	-0.22*	0.04	-0.27*	-0.09*	-0.10*	-0.13*	-0.02	1.00					
Agriculture/fishery	-0.03	-0.01	-0.17*	-0.08*	-0.18*	-0.21*	0.37*	0.08*	0.28*	-0.08*	-0.11*	0.24*	0.18*	-0.17*	1.00				
Trade	0.18*	0.14*	-0.08*	0.24*	0.14*	0.15*	-0.02	0.26*	0.17*	0.00	-0.12*	-0.25*	0.03	0.28*	-0.04	1.00			
Constriction	0.48*	0.48*	-0.09*	-0.04	0.56*	0.07*	-0.20*	-0.10*	0.03	-0.03	-0.04*	0.08*	0.16*	0.26*	-0.03	0.04	1.00		
Transport	0.26*	0.26*	-0.15*	-0.22*	0.06*	0.01	0.08*	-0.19*	0.03	-0.03	0.02	0.30*	0.01	-0.06*	-0.14*	-0.14*	0.10*	1.00	
Finance	0.09*	0.09*	0.21*	0.15*	0.35*	0.11*	-0.13*	0.08*	-0.05*	0.03	0.03	-0.30*	-0.03	0.11*	-0.22*	0.23*	0.15*	-0.23*	1.00
Education	-0.29*	-0.30*	0.25*	0.08*	-0.15*	-0.12*	-0.25*	-0.12*	-0.30*	0.00	0.07*	0.07*	-0.17*	0.24*	-0.56*	-0.08*	-0.05*	0.09*	-0.13*

Note: Level of statistical significance is 5%.
Source: CIS 1995-2006. All variables are taken in logarithms, excluding those in rations and percentage and binary values.

Table B3: Regression results philosophy – dependent variable – Number of SMEs

Specification	(1)	(2)	(3)	(4)
Estimation method	Pooled	Fixed Effects	System GMM	System GMM
SMEs lagged	0.912***	0.357***	0.468***	0.439***
	(0.03)	(0.03)	(0.14)	(0.14)
Public expenditure	-0.052	-0.038	-0.450*	-0.419*
	(0.05)	(0.06)	(0.23)	(0.23)
Capital investment	-0.059	-0.128	0.487	0.597*
	(0.06)	(0.08)	(0.36)	(0.36)
University	0.004**	-0.006	0.024***	0.023***
	(0.00)	(0.01)	(0.01)	(0.01)
University* manufacturing				0.001*
				(0.00)
Population density	-0.0179	0.625***	0.052	0.051
	(0.02)	(0.08)	(0.10)	(0.10)
Air pollution	-0.002	0.037	0.128	0.131
	(0.02)	(0.07)	(0.09)	(0.09)
Unemployment rate	-0.003	-0.001	-0.026	-0.024
	(0.01)	(0.01)	(0.01)	(0.02)
GDP per capita	-0.074	-0.027	-0.542**	-0.568**
	(0.05)	(0.05)	(0.23)	(0.24)
Banking reform	0.036	0.189*	0.807**	0.812**
	(0.12)	(0.11)	(0.38)	(0.38)
Executive constraints	-0.029*	-0.023	0.059	0.0584
	(0.02)	(0.03)	(0.05)	(0.06)
Criminality	-0.021	-0.016	-0.046	-0.049
	(0.02)	(0.03)	(0.08)	(0.08)
Freedom of doing business	-0.001	-0.002	0.004	0.002
	(0.00)	(0.00)	(0.00)	(0.00)
	Industrial controls			
Manufacturing/energy/mining	0.002	-0.008**	-0.002	-0.008
	(0.00)	(0.00)	(0.01)	(0.01)
Agriculture/fishery	0.001	0.001	0.004	0.002
	(0.00)	(0.00)	(0.01)	(0.01)
Trade	0.002	0.012*	0.006	0.001
	(0.00)	(0.01)	(0.01)	(0.01)
Constriction	0.001	0.006	0.003	0.002
	(0.00)	(0.00)	(0.01)	(0.01)
Transport	0.002	-0.002	0.008	0.005
	(0.00)	(0.01)	(0.02)	(0.02)
Finance	0.005	-0.008	0.036	0.015
	(0.01)	(0.02)	(0.03)	(0.03)
Education	-0.038***	0.008	-0.137**	-0.143**
	(0.01)	(0.02)	(0.06)	(0.06)
Year dummies	Yes	Yes	Yes	Yes
Country controls	No	No	Yes	Yes
Number obs.	732	732	732	732
R-square	0.96	0.49		
Pr>z AR(1) / Pr>z AR(2)			0.00/ 0.35	0.00/ 0.60
Hansen test, Pr.>chi2			0.24	0.24
Dif. Hansen test, Pr.>chi2			0.23	0.25

Source: Authors' calculations based on CIS Urban Audit dataset 1995-2008.

Notes: Level of statistical significance is * 0.1%. ** 0.05% and ***, 0.01%. Excluded instruments two: employment and unemployment. Year type dummies are supressed to safe space, only those important in interpreting the research hypothesis such as sector controls are kept for demonstrative purposes. Standard errors (in parentheses) are robust to heteroskedasticity. The figures reported for the Hansen test and Difference Hansen test are the p-values for the null

hypothesis: valid specification. Instruments for first differences equation GMM-type [L(2/.).(SMEs lagged Unemployment rate GDP per capita Capital investment)] collapsed. Instruments for levels equation: GMM-type [DL SMEs lagged Unemployment rate GDP per capita Capital investment) collapsed and all other regressors, including time controls, used as standard instruments here. Note: the autocorrelation test shows that the residuals are an AR(1) process which is what is expected. The test statistic for second-order serial correlation is based on residuals from the first-difference equation. F-test for excluded instruments shown in spec. 3-4 rejects null of instrument of the instruments applied in System GMM estimation to be not jointly significant: F test (35, 84) = 5978.83 for spec. 3 and Ftest(36, 84)= 5038.53 for spec. 4.

Appendix C

Table C1: Training premium equation: cross-section estimation by CIS

Dep. Var.: NPR in 000s £, log	CIS4 (2002-2004)			CIS5 (2004-2006)			CIS6 (2007-2009)		
Estimation method	OLS	2SLS	IV Tobit	OLS	2SLS	IV Tobit	OLS	2SLS	IV Tobit
Training	0.28*** (0.05)	3.45*** (0.58)	20.6*** (3.43)	0.33*** (0.06)	3.22*** (0.47)	14.8*** (2.29)	0.50*** (0.09)	5.14*** (0.74)	36.4*** (5.51)
Rivals	-0.14** (0.06)	-0.50*** (0.18)	-2.77*** (0.98)	-0.18*** (0.07)	-0.51*** (0.18)	-2.52*** (0.88)	-0.17*** (0.06)	-0.15 (0.15)	-0.78 (1.09)
Global	0.60*** (0.20)	1.20*** (0.41)	6.18*** (2.23)	0.84*** (0.18)	1.12*** (0.39)	4.64** (1.84)	1.02*** (0.18)	0.34 (0.37)	1.49 (2.57)
Public	0.29** (0.12)	0.81 (0.56)	6.84** (3.47)	0.31** (0.12)	1.00 (0.63)	5.55* (3.33)	0.23** (0.11)	0.01 (0.49)	-0.69 (3.63)
Foreign	-0.43 (0.27)	-0.91 (0.57)	-5.02 (3.08)	-0.40 (0.27)	-0.40 (0.57)	-2.37 (2.79)	0.033 (0.24)	0.81* (0.49)	6.20* (3.45)
Cooperation	2.36*** (0.39)	0.60 (0.65)	-3.45 (3.45)	2.85*** (0.46)	0.63 (0.69)	-1.25 (3.01)	2.13*** (0.34)	-1.33* (0.72)	-15.9*** (4.98)
Patents	2.08*** (0.21)	1.62*** (0.35)	6.43*** (1.93)	1.24*** (0.18)	0.59* (0.35)	2.94* (1.68)			
Scientists	0.11*** (0.02)	-0.16** (0.08)	-1.27*** (0.44)	0.11*** (0.02)	-0.080 (0.06)	-0.32 (0.31)	0.14*** (0.02)	-0.25*** (0.08)	-1.97*** (0.57)
Small firm	0.15 (0.13)	1.24*** (0.42)	7.86*** (2.39)	0.39*** (0.13)	1.65*** (0.44)	8.99*** (2.19)	0.31*** (0.12)	1.15*** (0.36)	9.05*** (2.60)
Large firm	0.11 (0.19)	-1.99*** (0.57)	-12.8*** (3.25)	0.11 (0.18)	-1.31** (0.52)	-7.02*** (2.50)	-0.13 (0.15)	-0.57 (0.38)	-6.12** (2.78)
Biotech and pharmaceutical	-1.33 (0.89)	-3.40* (1.89)	-15.3 (10.52)	-0.72 (1.01)	-0.11 (1.77)	-0.052 (8.11)	-0.30 (0.83)	-0.72 (1.80)	-3.02 (12.36)
Computers & electronic equipment	0.32 (0.51)	-0.75 (1.05)	-5.98 (5.57)	0.94* (0.55)	-0.69 (1.08)	-3.22 (4.80)	0.39 (0.48)	0.44 (0.88)	2.79 (6.03)
Machinery	0.20 (0.39)	-0.69 (0.74)	-4.36 (4.01)	-0.096 (0.38)	-0.95 (0.69)	-5.08 (3.25)	0.30 (0.34)	-0.11 (0.64)	-2.43 (4.41)
Instruments	0.91 (0.81)	0.50 (1.24)	-0.058 (6.51)	1.11 (0.73)	-0.21 (1.34)	-5.30 (5.84)	1.99*** (0.75)	-0.71 (1.13)	-12.4 (7.63)
Transportation	-0.53*** (0.15)	-1.21* (0.73)	-8.61* (4.47)	-0.21 (0.15)	0.01 (0.77)	-7.40 (5.34)	-0.14 (0.15)	-0.17 (0.60)	-2.04 (4.72)
Medical instruments	1.98 (1.21)	2.36 (2.33)	14.0 (12.47)	1.67 (1.59)	2.28 (2.31)	7.84 (10.18)	2.45** (1.07)	0.64 (2.08)	-1.81 (13.87)
Constant	0.89* (0.47)	-0.13 (1.31)	-27.3*** (7.51)	0.79 (0.49)	-0.33 (1.42)	-24.9*** (7.03)	0.98** (0.44)	-0.025 (1.17)	-29.5*** (8.57)
Obs.	3942	1779	1779	3662	1413	1413	4049	2152	2152
R-square	0.170	-0.976		0.164	-0.734		0.164	-1.406	
F statistics	26.24	10.45		20.69	9.36		20.33	10.85	
Sargan J-statistics		0.001			0.028			0.049	
Sargan J stat. p-value		0.96			0.86			0.82	
Anderson-Rubin chi-sq		86.83			100.15			143.53	
Kleibergen-Paap LM statistic p-value		0.00			0.00			0.00	
Uncensored obs.			307			268			360
Likelihood			-4864.3			-3974.0			-5117.5
Wald test chi2(1)			39.95			36.39			34.16
First stage estimates: Dep. Variable: Training expenditure, log									
Rivals			0.090** (0.04)			0.081* (0.04)			-0.013 (0.03)
Global			-0.16* (0.09)			-0.10 (0.10)			0.062 (0.06)
Public			-0.11 (0.13)			-0.22 (0.15)			0.01 (0.08)
Foreign			0.16 (0.13)			-0.20 (0.14)			-0.11 (0.08)
Cooperation			0.46*** (0.13)			0.49*** (0.15)			0.61*** (0.08)
Patents			0.03 (0.08)			0.05 (0.08)			

Scientists			0.01*** (0.01)			0.01*** (0.01)			0.01*** (0.01)
Small firm			-0.30*** (0.09)			-0.39*** (0.10)			-0.19*** (0.06)
Large firm			0.58*** (0.10)			0.51*** (0.11)			0.13** (0.06)
Biotech and pharmaceuticals			0.38 (0.44)			-0.36 (0.43)			0.14 (0.31)
Computers & electronic equipment			0.45* (0.23)			0.53** (0.26)			-0.02 (0.15)
Machinery			0.16 (0.17)			0.21 (0.17)			0.01 (0.11)
Instruments			0.044 (0.29)			0.61* (0.32)			0.40** (0.19)
Transportation			0.30* (0.17)			-0.20 (0.19)			-0.02 (0.10)
Medical instruments			-0.63 (0.53)			-0.51 (0.56)			0.31 (0.36)
Firm's capacity			0.24*** (0.03)			0.31*** (0.04)			0.16*** (0.02)
Market info			-0.03 (0.03)			0.06 (0.05)			0.05*** (0.02)
Constant			0.18 (0.30)			0.39 (0.34)			0.18 (0.20)
F – stat for instruments		29.83			37.24			27.13	

Notes: *** - significant at 0.01; ** - significant at 0.05; * - significant at 0.1. 3-digit SIC (92) dummies for Top6 industries viz. Machinery, Biotech and pharmaceuticals, computers and electronic equipment, transportation, instruments and medical instruments are reported. Standard errors are in parentheses robust to heteroskedasticity. HF index as a measure of competition intensity was taken out due to Top 6 sectors (SIC) control. Those sectors are introduced as SIC(92) classification.

Source: Office of National Statistics UK.

Table C2: Training premium equation: panel data estimation

Dep. Var.: NPR in 000s £, log	Estimation method						
	panel-data models				Instrumental variables for panel-data models		
	OLS	IMLE	RE	FE	RE	FE	EC2SLS RE
Training	0.32*** (0.04)	0.32*** (0.02)	0.32*** (0.02)	0.25*** (0.03)	3.77*** (0.34)	3.81*** (0.67)	3.81*** (0.40)
Rivals	-0.18*** (0.05)	-0.18*** (0.04)	-0.18*** (0.04)	-0.016 (0.15)	-0.40*** (0.10)	0.22 (0.48)	-0.37*** (0.10)
Global	0.78*** (0.12)	0.78*** (0.09)	0.78*** (0.09)	0.36** (0.15)	0.95*** (0.23)	0.66 (0.47)	0.90*** (0.22)
Public	0.30*** (0.08)	0.30** (0.12)	0.30** (0.12)	-	0.55* (0.33)	-	0.57* (0.30)
Foreign	-0.22 (0.19)	-0.22 (0.14)	-0.22 (0.14)	-	-0.15 (0.32)	-	-0.15 (0.29)
Cooperation	2.32*** (0.23)	2.31*** (0.14)	2.32*** (0.14)	1.89*** (0.17)	0.072 (0.38)	0.18 (0.56)	0.15 (0.40)
Patents	1.27*** (0.14)	1.25*** (0.10)	1.27*** (0.10)	0.62*** (0.11)	0.92*** (0.24)	0.38 (0.34)	1.01*** (0.20)
Scientists	0.12*** (0.01)	0.12*** (0.01)	0.12*** (0.01)	0.12*** (0.02)	-0.15*** (0.04)	-0.01 (0.06)	-0.11*** (0.03)
Small firm	0.24*** (0.08)	0.23*** (0.09)	0.24*** (0.09)	-0.022 (0.22)	1.25*** (0.24)	-0.52 (0.78)	1.02*** (0.20)
Large firm	0.030 (0.12)	0.030 (0.10)	0.030 (0.10)	-0.068 (0.33)	-1.28*** (0.28)	-0.76 (1.30)	-1.05*** (0.21)
Biotech and pharmaceuticals	-0.58 (0.70)	-0.57 (0.50)	-0.58 (0.50)	-0.17 (1.36)	-1.26 (1.10)	2.62 (4.06)	-1.32 (0.98)

Computers & electronic equipment	0.50 (0.36)	0.50* (0.27)	0.50* (0.26)	-0.38 (0.82)	-0.46 (0.60)	-0.80 (2.59)	-0.39 (0.50)
Machinery	0.20 (0.26)	0.21 (0.19)	0.20 (0.19)	0.061 (0.63)	-0.57 (0.42)	-0.77 (2.04)	-0.50 (0.35)
Instruments	1.54*** (0.53)	1.55*** (0.35)	1.54*** (0.35)	2.15** (0.97)	0.13 (0.74)	-1.56 (3.03)	0.17 (0.65)
Transportation	-0.32*** (0.10)	-0.33** (0.16)	-0.32** (0.16)	-0.72 (0.82)	-0.52 (0.41)	-5.04 (4.00)	-0.49 (0.37)
Medical instruments	2.20*** (0.83)	2.21*** (0.65)	2.20*** (0.64)	2.39 (2.10)	2.26* (1.36)	-0.42 (5.57)	2.00* (1.02)
Year dummy CIS5	-0.28*** (0.07)	-0.28*** (0.07)	-0.28*** (0.07)	-0.27*** (0.07)	-0.12 (0.21)	-0.33 (0.25)	-0.14 (0.19)
Year dummy CIS6	0.01 (0.07)	0.01 (0.07)	0.01 (0.07)	-0.16** (0.07)	2.38*** (0.31)	2.00*** (0.50)	2.20*** (0.24)
Constant	1.11*** (0.32)	1.12*** (0.31)	1.11*** (0.31)	0.87 (0.96)	-0.92 (0.81)	-3.37 (3.16)	-0.60 (0.74)
Obs.	11653	11653	11653	11653	5344	5344	5013
Sigma u	1.56	1.64	1.56	2.44	2.40	5.29	2.40
Sigma e	2.93	2.93	2.93	2.93	5.72	5.72	5.72
Rho	0.22	0.24	0.22	0.41	0.15	0.46	0.15
chi2	745.414	1508.95	1740.58		468.1	706.8	468.1
F_f				1.91		0.55	
Chibar2		589.49					

Notes: *** - significant at 0.01; ** - significant at 0.05; * - significant at 0.1 Standard errors are in parentheses robust to heteroskedasticity.

Note: Panel data estimation models: OLS (Pooled OLS)- , FE (Fixed) -, RE random-effects, and IMLE (Iterative maximum likelihood estimation) models; EC2SLS RE (Baltagi's EC2SLS random-effects estimator). F_f – F-test that all u_i=0 – rejected marginally at 10% revel for the panel data estimation and did not rejected for the instrumented panel-data models. Chibar2 is a Likelihood-ratio test of Sigma u=0 rejected at 1% level in favour of random effects. Hausman test (HT) chi2=171,0 signalling the endogeneity problem between the regressors and residuals in the model. This is also true for the instrumented regression (column (5-7) when two Hausman tests were performed: fixed effects vs. random effects estimator and fixed effects vs. Baltagi random effects estimators. Both HT reject the exogeneity of RE with the chi2=31.0 and EC2SLS RE with chi2=29.0. Although HT says that the error term is contaminated with endogeneity, Likelihood-ratio test of Sigma u=0 confirm the presence of random effects in the model. Lack of market information as a constraint to innovation and the importance of increased capacity for production or service provision were used as instruments.

Source: Office of National Statistics UK.

Table C3: Training -premium equation: firm age split

Dep. Var.: NPR in 000s £, log	Start-ups	Mature firm	Start-ups	Mature firm
Estimation method	OLS	OLS	Baltagi RE	Baltagi RE
Training	0.36***	0.32***	2.78***	3.32***
	(0.14)	(0.04)	(0.55)	(0.31)
Rivals	-0.097	-0.19***	0.042	-0.44***
	(0.12)	(0.05)	(0.23)	(0.10)
Global	1.27***	0.74***	1.22**	0.95***
	(0.43)	(0.13)	(0.59)	(0.22)
Public	0.49**	0.26***	0.25	0.53
	(0.23)	(0.08)	(0.81)	(0.33)
Foreign	0.52	-0.27	1.00	-0.27
	(0.75)	(0.19)	(1.00)	(0.32)
Cooperation	2.58***	2.28***	1.72**	0.25
	(0.58)	(0.25)	(0.75)	(0.36)
Patents	1.48***	1.25***	1.86***	0.87***
	(0.46)	(0.14)	(0.59)	(0.23)
Scientists	0.15***	0.12***	-0.038	-0.10***
	(0.05)	(0.01)	(0.09)	(0.04)
Small firm	0.39	0.20**	2.06***	1.01***
	(0.26)	(0.09)	(0.55)	(0.24)
Large firm	-0.14	0.065	1.27*	-1.24***
	(0.38)	(0.12)	(0.77)	(0.29)
Biotech and pharmaceuticals	-2.83***	-0.23	-4.51*	-0.84
	(0.72)	(0.79)	(2.40)	(1.12)
Computers & electronic equipment	-0.97	0.78*	-1.50	-0.14
	(0.68)	(0.41)	(0.98)	(0.64)
Machinery	-0.28	0.25	-0.033	-0.52
	(0.91)	(0.27)	(1.51)	(0.42)
Instruments	0.85	1.62***	-0.75	0.26
	(1.73)	(0.55)	(2.81)	(0.73)
Transportation	-0.19	-0.33***	0.63	-0.55
	(0.37)	(0.10)	(1.17)	(0.41)
Medical instruments	4.04***	2.01**	4.08	1.82
	(1.23)	(0.89)	(4.91)	(1.35)
Year dummy CIS5	-0.47**	-0.25***	-0.88	-0.10
	(0.22)	(0.07)	(0.57)	(0.20)
Year dummy CIS6	-0.12	0.027	0.81	2.17***
	(0.19)	(0.07)	(0.58)	(0.29)
Constant	0.47	1.22***	-2.85	-0.21
	(0.90)	(0.35)	(1.81)	(0.81)
Obs.	1209	10444	520	4824
Sigma u	1.41	1.57	0	2.90
Sigma e	2.90	2.93	6.67	5.58
Rho	0.19	0.22	0	0.21
chi2	180.10	635.15	115.33	454.49

Notes: *** - significant at 0.01; ** - significant at 0.05; * - significant at 0.1 Standard errors are in parentheses robust to heteroskedasticity. Lack of market information as a constraint to innovation and the importance of increased capacity for production or service provision were used as instruments.
Source: Office of National Statistics UK.

Table C4: The patent (revenue) premium at different levels of patent propensity

CIS wave		CIS3	CIS4	CIS5
Coefficient estimated from the model		0.91	0.49	0.57
Patent propensity (ϕ_i)	1/3	2.75	1.48	1.72
	½	1.82	0.98	1.14
	2/3	1.37	0.74	0.86

Note: Each cell represents the value of the patent premium for a given level of patent propensity and based on coefficient estimates of patent effectiveness reported in Arora et. al. (2011).
Source: Arora et. al. (2011).

Bibliography

Acemoglu, D. 1997. Training and Innovation in an Imperfect Labour Market. Review of Economic Studies 64, 445-464.

Acemoglu, D., Johnson S. 2005. Unbundling institutions. Journal of Political Economy 113, 943-995.

Acosta, M., Coronado, D., León, M.D., Martínez, M.A. 2009. Production of university technological knowledge in European regions: Evidence from patent data, Regional Studies 43 (9), 1167-1181.

Acs, J. Z., and D.B. Audretsch. 1987a. Innovation, Market Structure, and Firm Size. The Review of Economics and Statistics 69(4), 567–574.

Acs, J. Z., and D.B. Audretsch. 1987b. Innovation in Large and Small Firms. Economic letters 23(1), 109–112.

Acs, Z., Audretsch, B.D., 1990. Innovation and small firms. MIT press, Cambridge.

Acs, Z., Armington, C. 2004a. Employment Growth and Entrepreneurial Activity in Cities. Regional Studies 38(8), 911-927.

Acs, Z., Armington, C. 2004b. The impact of geographic differences in human capital on service firm formation rates. Journal of Urban Economics 56, 244–278.

Acs ,Z, Bosma, N, Sternberg, R. 2008. The Entrepreneurial Advantage of World Cities: Evidence from Global Entrepreneurship Monitor Data, SCALES Research Report H200810. http://www.entrepreneurship-sme.eu/pdf-ez/H200810.pdf. (assessed November 2011)

Acs, Z. 2010. High-Impact Entrepreneurship.In Handbook of Entrepreneurship Research. An Interdisciplinary Survey and Introduction, Acs ZJ. Audretsch D.B. (eds). Springer: New York: 165-182.

Afanasieff, T., Priscilla, L., Nakane, M. 2002. The Determinants of Bank Interest Spreads in Brazil. Working paper 46, Central Bank of Brazil.

Agénor, P., Aizenman, J., Hoffmaister, A.W. 2008. External shocks, bank lending spreads, and output fluctuations. Review of International Economics 16 (1), 1–20.

Agénor, P., Aizenman J. 1998. Contagion and Volatility with Imperfect Credit Markets. IMF Staff Papers 45(2), 207–235.

Aghion P, Howitt P. 1992. A model of growth through creative destruction.Econometrica 60(2), 323–351.

Agarwal R., Audretsch D.B, Sarkar M.B. 2007. The Process of Creative Construction: Knowledge Spillovers, Entrepreneurship and Economic Growth, Strategic Entrepreneurship Journal 1(3-4), 263-286.

Agrawal, A., Kapur, D., McHale, J. 2008. How do spatial and social proximity influence knowledge flows? Evidence from patent data. Journal of Urban Economics 64(2), 258-269.

Ahlstrom, D., Bruton G.D. 2002. An institutional perspective on the role of culture in shaping strategic actions by technology-focused entrepreneurial firms in China. Entrepreneurship Theory and Practice 26(4), 53–70.

Aidis, R, Estrin, S, Mickiewicz, T. 2008. Institutions and entrepreneurship development in Russia: a comparative perspective. Journal of Business Venturing 23(6), 656-672.

Aidis, R, Korosteleva, J, Mickiewicz, TM. 2009. Russia. In Handbook of Research on Asian Entrepreneurship, Dana L.P. Han M. Ratten V. Welpe IM. (eds). Edward Elgar: Cheltenham, UK.

Aidis, R., Estrin, S., Mickiewicz, T., 2010. Size matters: entrepreneurial entry and government. Small Business Economics, 1–21.

Ardagna, S, Lusardi, A. 2008. Explaining International Differences in Entrepreneurship: the Role of Individual Characteristics and Regulatory Constraints.Working Paper 14012, NBER.

Arellano, M., Bond, S. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies 58(2), 277–297.

Arellano, M., Bover. O. 1995. Another look at the instrumental variable estimation of error-components models. Journal of Econometrics 68(1), 29–51.

Arora, A., Ceccagnoli, M., Cohen, W.M. 2008. R&D and the patent premium. International Journal of Industrial Organization 26(5), 1153–1179.

Arora, A, Athreye, S., Belitski, M. 2011. Returns to patenting. Report on IPO UK project 'Patent incentives' No 11004. IPO UK September 2011.

Arrow, K. 1962. Economic welfare and the allocation of resources for invention, in: Nelson, R. (Eds), The Rate and Direction of Inventive Activity, Princeton University Press, Princeton.

Artz, K.W., Norman, P.M., Hatfield, D.E., Cardinal, L.B. 2010. A longitudinal study of the impact of R&D, patents, and product innovation on firm performance, Journal of Product Innovation Management 27 (5), 725-740.

Audretsch, DB, Keilbach M. 2007. The Theory of Knowledge Spillover Entrepreneurship, Journal of

Management Studies 44(7): 1242-1254.
Autio, E., Acs, Z. 2010. Intellectual property protection and the formation of entrepreneurial growth aspirations.Strategic Entrepreneurship Journal 4(3), 234–251.
Baldwin, J.R., Johnson, J. 1995. Human capital development and Innovation: The Case of Training in small and Medium-sized firms. Report 11F0019MPE No. 74; Micro-Economic analysis Division, Statistics Canada.
Baltagi, H.B. 2008. Econometric Analysis of Panel Data, 4th Edition, Wiley
Barajas, A., Steiner, R., Salazar, N. 1999. Interest Spreads in Banking in Colombia 1974–96. IMF Staff Papers 46(2), 196–224.
Baron, R.A. 2007. Behavioral and Cognitive Factors in Entrepreneurship: Entrepreneurs as the Active Element in New Venture Creation. Strategic Entrepreneurship Journal 1(1-2), 167-182.
Barberis, N, Boycko, M, Shleifer, A, Tsukanova, N. 1996. How Does Privatization Work? Evidence from the Russian Shops.Journal of Political Economy 104(4), 764-791
Barrett, A. and P.J. O'Connell. 2001. Does training generally work? The returns to in-company training, Industrial and Labor Relations Review, 54, pp. 647-662.
Bartel, A.P. 1994. Productivity gains from the implementation of employee training programs, Industrial Relations 33, 411-25
Bartel, A.P. 2000. Measuring the Employer's Return on Investments in Training, Evidence from the Literature. Industrial Relations: A Journal of Economy and Society, 39(3), 502–524.
Bassi, L.J. 1984. Estimating the effect of training programs with non-random selection.
Review of Economics and Statistics 66 (1), 36-43.
Baumol, W. 1990. Entrepreneurship: Productive, Unproductive, and Destructive. Journal of Political Economy 98 (5), 893-921.
Baumol, W. 1993. Entrepreneurship, Management and the Structure of Payoffs. MIT Press, Cambridge.
Baumol, WJ, Litan, RE, Schramm, CJ. 2007. Sustaining entrepreneurial capitalism. Capitalism and Society 2(2), 1-36.
Baumol, WJ, Strom, R.J. 2007. Entrepreneurship and Economic Growth. Strategic Entrepreneurship Journal 1(3-4), 233-237
Beach, W., Kane, T., 2008. Methodology: Measuring the 10 Economic Freedoms, in: Holmes, K., Feulner, E., O'Grady, M. (Eds), 2008 Index of Economic Freedom, The Heritage Foundation, Washington, pp. 39–55.
Beck T, Demirgüç-Kunt A, Maksimovic V. 2005. Financial and Legal Constraints to Growth: Does the Firm Size Matter? The Journal of Finance 60(1), 137–177.
Belitski, M, Korosteleva, J. 2010 Entrepreneurial activity across European cities. Frontiers of Entrepreneurship Research: 30(4). http://digitalknowledge.babson.edu/fer/vol30/iss4/12 (accessed November 2011)
Bernanke, B., Gertler, M., Gilchrist, S., 2000. The financial accelerator in a quantitative business cycle framework, in: Taylor, J.B. (Eds.), Handbook of Macroeconomics, vol. 1, Elsevier, Oxford, pp. 1341-1393.
Birch, D., 1987. Job generation in America. The Free Press, New York.
Bishop, J. H. 1991. On-the-job Training of New Hires, in: Stern, D. and Ritzen J. M. M. (Eds.), Market Failure in Training? Springer-Verlag, New York, pp. 61-98.
Bishop, J. H. 1997. What We Know About Employer-Provided Training, in: Polachek, S. (Eds.), Research in Labor Economics, JAI Press, Greenwich, CT, pp.19-87.
Begley, T.M and Boyd D.P. 1987. Psychological characteristics associated with performance in entrepreneur firms and smaller businesses. Journal of Business Venturing 2(1): 79-93.
Black, S.E., Lynch, L.M. 1996. Human-capital Investments and Productivity. American Economic Review Papers and Proceedings, 86(2), 263-267.
Black, S.E., Lynch, L.M. 2001. How to Compete: The Impact of Workplace Practices and Information Technology on Productivity, Review of Economics and Statistics 83(3), pp. 434-445.
Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics 87(1), 115–143.
Blundell, R., Bond, S., Windmeijer, F., 2000. Estimation in Dynamic Panel Data Models: Improving on the Performance of the Standard GMM Estimators. Working paper 00/12. Institute of Fiscal Studies, London.
Boettke, P.J., Coyne, C.J. 2009. Context matters: institutions and entrepreneurship. Foundations and Trends in Entrepreneurship 5(3), 135-209.
Bolton, P., Whinston, M. 1993. Incomplete Contracts, Vertical Integration, and Supply Assurance. The Review of Economic Studies 60(1), 121–148.
Bond, S. 2002. Dynamic panel data models: A guide to micro data methods and practice. Working Paper 09/02,

Institute for Fiscal Studies.
Bosma, N., Schutjens, V. 2007. Patterns of promising entrepreneurial activity in European regions. Tijdschrift voor Economische en Sociale Geografie 98 (5), 675-686.
Bosma, N., Schutjens, V. 2009. Mapping entrepreneurial activity and entrepreneurial attitudes in European regions. International Journal of Entrepreneurship and Small Business 7 (2), 191-213.
Botric, V., Slijepcevic S. 2008. Economic growth in South-eastern Europe: The role of the banking sector. Post-Communist Economies 20 (2), 253–262.
Bowen, H.P., DeClercq, D. 2008. Institutional Context and the Allocation of Entrepreneurial Effort.Journal of International Business Studies 39(4), 747-767.
Branzei, O., Vertinsky, I. 2006. Strategic pathways to product innovation capabilities in SMEs. Journal of Business Venturing 21, 75– 105.
Bruton, G.D., Ahlstrom, D., Li, H-L. 2010. Institutional Theory and Entrepreneurship: Where are We Now and Where Do We Need to Move in the Future? Entrepreneurship Theory and Practice 34(3), 421-440.
Bulut, H., Moschini, G. 2009. US universities' net returns from patenting and licensing: a quantile regression analysis. Economics of Innovation and New Technology, Taylor and Francis Journals, 18(2), 123-137.
Busenitz, LW, Gomez C, Spencer JW. 2000. Country Institutional Profiles: Unlocking Entrepreneurial Phenomena. Academy of Management Journal 43(5), 994-1003.
Cameron, A.C., Trivedi, P.K. 2005. Microeconometrics. Methods and Applications. Cambridge: Cambridge University Press.
Cameron, A.C, Trivedi, P.K. 2009. Microeconometrics using Stata. College Station: Stata Press.
Cassidy, M.. Görg, H., Strobl, E. 2005. Knowledge accumulation and productivity: Evidence from plant level data for Ireland. The University of Nottingham Research Paper Series, 2005/04.
Charemza, W., Makarova, S., Prytula, Y., Raskina, J., Vymyatnina, Y. 2009. A small forward-looking inter-country model (Belarus, Russia and Ukraine). Economic Modelling 26(6), 1172-1183.
Chatterton, P., Goddard, J. 2000. The Response of Higher Education Institutions to Regional Needs.European Journal of Education 35(4), 475-496.
Chudik, A., Pesaran, M., 2007. Infinite-dimensional VARs and factor models. IZA Discussion Paper 3206.
Chudik, A., Pesaran, M., 2009. Infinite-dimensional VARs and factor models. IZA Discussion Paper 3207.
Chudik, A., Pesaran, M., 2010. Econometric Analysis of High Dimensional VARs Featuring a Dominant Unit. Working Paper Series 3055, CESifo.
Coakley, J., Fuertes, A. 2002. Asymmetric dynamics in UK real interest rates. Applied Financial Economics 12(6), 379–387.
Cogley, T., Nason, J., 1995. Effects of the Hodrick–Prescott Filter on Trend and Difference Stationary Time Series: Implications for Business Cycle Research. Journal of Economic Dynamics and Control 19(1), 253-278.
Cohen, W.M., Klepper, S. 1996. Firm Size and the Nature of Innovation within Industries: The Case of Process and Product R&D. The Review of Economics and Statistics 78(2): 232–243.
Cohen, W., Nelson, R., Walsh, J. 2001. Protecting their intellectual assets: appropriability conditions and why U.S. manufacturing firms patent (or not). NBER Working Paper No. 7552.
Cooley, T.F., Dwyer, M., 1998. Business cycle analysis without much theory. A look at Structural Vars. Journal of Econometrics 83(1-2), 57-88.
Davidson, P., Honig, B. 2003. The Role of Social and Human Capital amongst Nascent Entrepreneurs.Journal of Business Venturing 18: 301-331.
Deeds, D.L., Hill, C.W.L. 1998. An examination of opportunistic action within research alliances: evidence from the biotechnology industry. J. Bus. Venturing 14, 141–163.
De La Torre, A., Peria, M., Schmukler, S. 2008. Bank Involvement with SMEs: Beyond Relationship Lending, Working Paper Series 4649, World Bank.
Demirgüç-Kunt, A., Huizinga, H. 1999. Determinants of Commercial Bank Interest Margins and Profitability: some International Evidence. World Bank Economic Review 13 (2), 379–408.
Demirgüç-Kunt, A., Love, I., Maksimovic, V. 2006. Business Environment and the Incorporation Decision. Journal of Banking and Finance 30(1), 2967–2993.
De Soto, H. 1990.The Other Path. New York, NY: Harper and Row.
DiMaggio, PJ., Powell, WW. 1983. The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. American Sociological Review 48(2), 147-160.
Djankov, S., LaPorta, R., Lopez-De-Silanes, F., Shleifer, A. 2002. The regulation of entry, Quarterly Journal of Economics, CXVII (1), 1-36.

Driscoll, J., Kraay, A. 1998. Consistent covariance matrix estimation with spatially dependent panel data. Review of Economics and Statistics 80 (4), 549–560.
Dumbrell, T. 2002. Industry differences in expenditure training, UTS Research Centre for Vocational Education and Training. Working Paper 02-06.
Duranton, G., Puga, D., 2004. Micro-foundations of urban agglomeration economies, in: Henderson, J.V., Thisse, J.-F., (Eds.), Handbook of Urban and Regional Economics, vol. 4, Elsevier, Amsterdam, pp. 2063–2118.
EBRD 2010. Transition report 2010: Recovery and reform. http://www.ebrd.com/pages/research/publications/flagships/transition.shtml. (Accessed November 2011)
EPO Annual Report. 2003. http://annual-report.european-patent-office.org/2003/
Estrin, S, Meyer, K, Bytchkova, M. 2006. Entrepreneurship in Transition Economies. In The Oxford Handbook of Entrepreneurship,Casson M (eds.). Oxford: Oxford University Press: 693-723.
Estrin, S., Korostelva, J., Mickiewicz, T. 2011. Which Institutions Encourage Entrepreneurs to Create Larger Firms? Discussion Paper 8247, CEPR.
Estrin, S., Mickiewicz, T. 2011. Entrepreneurship in transition economies: the role of institutions and generational change, in: Minniti, M. (Eds.), The Dynamics of Entrepreneurship, Oxford University Press, Oxford, pp. 293–338.
Etzkowitz, H., Leydesdorff, L. 1999. The Future Location of Research and Technology Transfer.Journal of Technology Transfer 24: 111-123.
Etzkowitz, H. 2002. Incubation of incubators: innovation as a triple helix of university-industry-government networks. Science and Public Policy 29(2), 115-128.
European Commission 2007. The state of European Cities Report.
Faems, D., Van Looy, B., Debackere, K. 2005. Interorganizational collaboration and innovation: toward a portfolio approach. Journal of Product Innovation Management 22(3), 238–250
Farooqui, S., Goodridge, P., Haskel, J. 2011. The Role of Intellectual Property Rights in the UK Market Sector. IPO, July 2011.
Faust, J., Leeper, E.M. 1997. When do long run identifying restrictions give reliable results. Journal of Business and Economic Statistics 15(3), 345-353.
Frenz, M., Ietto-Gillies, G. 2009. The impact on innovation performance of different sources of knowledge: evidence from the UK Community Innovation Survey. Research Policy 38(7), 1125–1135.
Fries, S., Taci, A. 2002. Banking Reform and Development in Transition Economies.Working Paper 71, EBRD.
Galia, F., Legros, D. 2004. Research and Development, Innovation, Training, Quality and Profitability: Evidence from France. Working Papers ERMES 0411. ERMES-UMR-7017-CNRS Université Panthéon-Assas Paris II.
Gambardella, A, Giarratana M. 2010. Localized knowledge spillovers and skill-based performance.Strategic Entrepreneurship Journal 4, 323–339.
Genberg, H. 2003. Foreign versus domestic factors as sources of macroeconomic fluctuations in Hong Kong. Working Paper 17, Hong Kong Institute for Monetary Research.
Genberg, H., Sulstarova, A. 2008. Macroeconomic volatility, debt dynamics, and sovereign interest rate spreads. Journal of International Money and Finance 27 (1), 26-39.
George, G., Zahra, S.A., Wood, R.D. 2002. The effects of business–university alliances on innovative output and financial performance: a study of publicly traded biotechnology companies. J. Bus. Venturing 17, 577–609.
Gerlach, H., Ronde, T., Stahl, K., 2009. Labor pooling in R&D intensive industries. Journal of Urban Economics 65(1), 99–111.
Geroski, P. 1995. What Do We Know About Entry? International Journal of Industrial Organisation 13(4), 421 – 440.
Gilchrist, S., Yankov, V., Zakrajsek, E. 2009. Credit market shocks and economic fluctuations: Evidence from corporate bond and stock markets. Journal of Monetary Economics 56(4), 471–493.
Glaeser, E.L., La Porta, R., Lopez-de-Silanes, F., Shleifer, A. 2004. Do institutions cause growth? Working Paper 10568, NBER.
Glaeser, E.L. 2007. Entrepreneurship and the City. Working Paper 13551, NBER.
Glaeser, E.L., Rosenthal S.S., Strange W.C. 2010. Urban economics and entrepreneurship. Journal of Urban Economics 67, 1–14.
Glaeser, E.L., Kerr, W.R. 2009. Local industrial conditions and entrepreneurship: how much of the spatial distribution can we explain? Journal of Economics and Management Strategy 18(3), 623–663.

Glinkina, S. 2003. Small Business, Survival Strategies and the Shadow Economy, in: McIntyre, R., Dallago, B. (Eds), Small and Medium Enterprises in Transitional Economies, Palgrave, Hampshire, pp. 51–63.
Gorodnichenko Y, Schnitzer M. 2010. Financial constraints and innovation: Why poor countries don't catch up. Working papers 15792, NBER.
Granovetter, M. 1985. Economic action and social structure. The problem of embeddedness. American Journal of Sociology 1(3): 481-510.
Gran,t RM. 1996. Towards knowledge based theory of the firm. Strategic Management Journal 17: 109-122.
Greenhalgh, C., Rogers, M. 2006. The value of innovation: The interaction of competition, R&D and IP, Research Policy 35(4), 562-580.
Grilo, I, Thurik, R. 2005. Latent and Actual Entrepreneurship in Europe and the US: Some Recent Developments. International Entrepreneurship and Management Journal 1(4), 441-459.
Gunasekara, CS. 2004. The Third Role of Australian Universities in Human Capital Formation.Journal of Higher Education Policy and Management 26(3), 329-343.
Hall, B., Helmers, C., Rogers, M, Sena, V. 2011. The choice between formal and informal intellectual property: a review. Accessible at: http://www.chelmers.com/projects.
Harmon, B., Ardishvili, A., Cardozo, R., Elder, T., Leuthold, J., Parshall, J., Raghian, M., Smith, D. 1997. Mapping the university technology transfer process. J. Bus. Venturing 12, 423–434.
Hansson, B. 2007. Company-based determinants of training and the impact of training on company performance. Results from an international HRM survey. Personnel Review 36(2), 311-331
Herron, L. Robinson, R.B. 1993. A structural model of the effects of entrepreneurial characteristics on venture performance. Journal of Business Venturing 8(3): 281-294
Holzer, H.J., Block, R.N., Cheatham, M., Knott, J.H. 1993. Are training subsidies for firms effective? The Michigan experience. Industrial and Labor Relations Review 46(4), 625-636.
Harabi, N. 1995. Appropriability of technical innovations an empirical analysis, Research Policy 24 (6), 981-992
Hitt, MA, Ireland RD, Camp SM, Sexton DL. 2001. Strategic Entrepreneurship: Entrepreneurial Strategies for Wealth Creation. Strategic Management Journal 22(6/7), 479-491.
Hofstede, G. 1980. Culture's Consequences: International Differences in Work-Related Values. Sage Publications: Beverly Hills, CA.
Holland, BA. 2001. Toward a definition and characterization of the engaged university. Metropolitan Universities 2(3), 20-29.
Horstmann, I., MacDonald, J.M., Slivinski, A. 1985. Patents as information transfer mechanisms: to patent or (maybe) not to patent. Journal of Political Economy 93, 837–858.
Huselid, M.A. 1995. The Impact of Human Resource Management Practices on Turnover, Productivity, and Corporate Financial Performance, The Academy of Management Journal 38(3), 635-672.
Huselid, M.A., Becker, B. 1996. Methodological Issues in Cross-Sectional and Panel Estimates of the Human Resource-Firm Performance Link. Industrial Relations: A Journal of Economy and Society 35(3), 400–422
Huyghebaert N, Van de Gucht L. 2007. The Determinants of Financial Structure: New Insights from Business Start-ups. European Financial Management 13(1), 101-133.
Ichniowski, C., Shaw, K., Prennushi, G. 1997. The Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines. The American Economic Review 87(3), 291-313.
Ireland, RD, Hitt MA, Sirmon D.G. 2003. A Model of Strategic Entrepreneurship: the Construct and its Dimensions. Journal of Management 29(6), 963-989.
Johnson, S., McMillan, J., Woodruff, C. 2002. Property Rights and Finance. The American Economic Review 92(5), 1335–1356.
Kammerer, D. 2009. The Effects of Customer Benefit and Regulation on Environmental Product Innovation. Empirical Evidence from Appliance Manufacturers in Germany. Ecological Economics 68(8-9), 2285–2295.
Klapper, L, Sarria-Allende, V, Sulla, V. 2002. Small- and Medium-Size Enterprise Financing in Eastern Europe.Working Paper 2933, World Bank Policy Research.
Klapper L, Laeven L, Rajan R. 2006. Entry Regulation as a Barrier to Entrepreneurship.Journal of Financial Economics 82(3), 591–629.
Kleinknecht, A., Van Montfort, K., Brouwer, E. 2002. The Non-trivial Choice Between Innovation Indicators. Economics of Innovation and New Technology 11(2), 109–121.
Kontorovich, V. 1999. Has New Business Creation in Russia come to a halt? Journal of Business Venturing 14(5-6), 451–460.

Korosteleva, J, Lawson, C. 2010. The Belarusian Case of Transition: Whither Financial Repression? Post-Communist Economies, 22(1).
Korosteleva, J, Isachenkova, N. Rodionova, Y. 2011. The Effect of the Crisis on Firm Financing in Transition Economies: Whether Size Matters? mimeo.
Kortum, S., Lerner, J. 1998. Stronger protection or technological revolution: what is behind the recent surge in patenting? Carnegie-Rochester Conference Series on Public Policy 48, 247–304.
Kortum, S.S., Eaton, J. 1999. International technology diffusion: Theory and measurement. International Economic Review 40 (3), 537-570
Krueger, NF., Reilly, MD., Carsrud, AL. 2000.Competing Models of Entrepreneurial Intentions.Journal of Business Venturing 15(5-6), 411-432.
Kreiser, PM, Marino, LD., Dickson, P., Weaver, KM. 2010. Cultural Influences on Entrepreneurial Orientation: The Impact of National Culture on Risk Taking and Proactiveness in SMEs. Entrepreneurship Theory and Practice 34(5): 959-983.
Laursen, K., Salter, A. 2006. Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. Strategic Management Journal 27(2), 131-150.
Leiponen, A., Byma, J. 2009. If you cannot block, you better run: Small firms, cooperative innovation, and appropriation strategies, Research Policy 38(9), 1478-1488
Lerner, J. 2009. The Empirical Impact of Intellectual Property Rights on Innovation: Puzzles and Clues. American Economic Review 99, 343-348.
Levin, R., Klevorick, A., Nelson, R., Winter, S. 1987. Appropriating the Returns from Industrial Research and Development. Brookings Papers on Economic Activity: Microeconomics, 783-820.
Levine, R., 1997. Financial development and economic growth: views and agenda. Journal of Economic Literature 35(2), 688–726.
Maier, N. 1965. Psychology in Industry. (3rd ed.) Boston: Houghton Mifflin Co.
Marotta, D., Mark, M., Blom, A., Thorn, K. 2007. Human Capital and University-Industry Linkages' Role in Fostering Firm Innovation: An Empirical Study of Chile and Colombia, Policy Research Working Paper 4443, The World Bank, Washington, DC.
Mandelman, F., Montes-Rojas, G.V. 2009. Is Self-employment and Micro-entrepreneurship a Desired Outcome? World Development 37(12), 1914-1925.
Manolova, TS., Eunni, RV, Gyoshev, BS. 2008. Institutional Environments for Entrepreneurship: Evidence from Emerging Economies in Eastern Europe. Entrepreneurship Theory and Practice 32(1), 203-218.
Marshall, A. 1890, Principles of Economics. MacMillan and Co, London.
McCarthy, DJ, Puffer, SM, Shekshnia, S. 1993. The resurgence of an entrepreneurial class in Russia .Journal of Management Inquiry 2(2),125–137.
McMillan, D., 2002. Interest rate spread and real activity: evidence for the UK. Applied Economics Letters 9(3), 191–194.
Mendonça, S. 2004. Brave old world: Accounting for 'high-tech' knowledge in 'low-tech' industries. Research Policy 38(3), 470-482
Meyer, JW, Rowan, B. 1977. Institutionalised organisations: formal structures as myth and ceremony. American Journal of Sociology 83 (2), 340-363.
Mody, A., Taylor, M. 2003. The high-yield spread as a predictor of real economic activity: evidence of a financial accelerator for the United States. IMF Staff Papers 50(3), 373–402.
Mody, A., Taylor, M. 2004. Financial predictors of real activity and the financial accelerator. Economics Letters 82(2), 167-172.
Negassi, S. 2004. R&D cooperation and innovation a microeconometric study on French firms. Research Policy 33(3), 365–384.
Neumeyer, P., Perri, F. 2005. Business Cycles in Emerging Economies: the Role of Interest Rates. Journal of Monetary Economics 52(2), 345–380.
North, D. 1990. Institutions, Institutional Change and Economic Performance. Cambridge University Press, Cambridge.
Özatay, F., Özmen, E., Şahinbeyoğlu, G. 2009. Emerging market sovereign spreads, global financial conditions and U.S. macroeconomic news. Economic Modelling 26(2), 526–531.
Pagan, A. R., Robertson, J. C., 1998. Structural models of the liquidity effect. Review of Economics and Statistics 80 (2), 202-216.
Pakes, A. 1986. Patents as options: some estimates of the value of holding European Patent stocks.

Econometrics 54 (4), 755-784.
Pakes, A., Simpson, M. 1989. Patent Renewal Data. Brookings Papers on Economic Activity: Microeconomics, 331-410.
Pakes, A., Schankerman, M. 1984. The Rate of Obsolescence of Patents, Research Gestation Lags, and the Private Rate of Return to Research Resources, in: Griliches, Z. (Eds), R&D, Patents and Productivity, University of Chicago Press, Chicago.
Papadamou, S. 2009. Yield spreads and real economic activity in East European transition economies. Applied Economics Letters 16(5), 531–537.
Parker, S.C. 2009.The economics of entrepreneurship. Cambridge University Press: Cambridge.
Parker, S., Coleman, J. 1999. Training in the UK: does national ownership matter? International Journal of Training and Development 3(4), 278-291.
Pavitt, K. 1984. Sectoral patterns of technical change. Research Policy 13(6), 343–373.
Patel, D., Ward, M. 2011. Using patent citation patterns to infer innovation market competition. Research Policy 40(6), 886-894.
Peng, M. 2003. Institutional transitions and strategic choices. Academy of Management Review 28(2), 275–286.
Pesaran, M. 2004. General diagnostic tests for cross section dependence in panels. Cambridge Working Papers in Economics 0435, University of Cambridge.
Pesaran, M.H., Schuermann, T., Weiner, S.M. 2004. Modelling Regional Interdependencies Using A Global Error-Correcting Macroeconometric Model. Journal of Business and Economic Statistics 22(2), 129-162.
Pissarides, F. 1998. Is Lack of Funds the Main Obstacle to Growth? Working Paper 33, EBRD.
Pissarides, F. 1999. Is Lack of Funds the Main Obstacle to Growth? EBRD's Experience with Small-and Medium-sized Businesses in Central and Eastern Europe.Journal of Business Venturing 14: 519-539.
Pissarides, F. 2001. Financial Structure to Promote Private Sector Development in South-Eastern Europe. Working Paper 64, EBRD.
Pissarides, F, Singer M, Svejnar, J. 2003. Objectives and Constraints of Entrepreneurs: Evidence from Small and Medium Size Enterprises in Russia and Bulgaria. Journal of Comparative Economics 31, 503-531.
Porter, M.E., 1979. How competitive forces shape strategy. Harvard Business Review, March-April: 25-40. Available at: http://www.mktgsensei.com/AMAE/Strategy [6 June 2011].
Puffer, S, McCarthy, D, Boisot, M. 2009. Entrepreneurship in Russia and China: The Impact of Formal Institutional Voids. Entrepreneurship Theory and Practice 34(3), 441–467.
Robertson, D., Symons, J. 2000. Factor residuals in SUR regressions: estimating panels allowing for cross sectional correlation. CEP discussion paper 0473, Centre for Economic Performance, LSE.
Romer, P. 1990. Endogenous technological change. Journal of Political Economy 98, S71–S102.
Roodman, D. 2006. How to Do xtabond2: An Introduction to "Difference" and "System" GMM in Stata. Centre for global development. Working Paper 103.
Rosenbusch, N., Brinckmann, J., Bausch, A. 2011. Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. Journal of Business Venturing 26, 441–457
Rosenthal, SS, Strange WC. 2004. Evidence on the nature and sources of agglomeration economies. In Handbook of Urban and Regional Economics, Henderson JV.Thisse JF (eds). Elsevier: Amsterdam, 2119–2172.
Rosenthal SS, Ross A. 2010.Violent crime, entrepreneurship and vibrant cities.Journal of Urban Economics 67(1), 135–149.
Saxenian, A. 1994. Regional advantage. Culture and competition in Silicon Valley and Route 128. Harvard University Press, Cambridge.
Saxenian, A. 2007. The New Argonauts: Regional Advantage in a Global Economy. Harvard University Press: Cambridge, MA.
Schankerman, M. 1998. How valuable is patent protection? Estimates by technology field. RAND Journal of Economics 29(1), 77–107.
Scherer, F. 1983. The propensity to Patent. International Journal of Industrial Organisation 1(1), 107-128.
Schumpeter, J.A. 1939. Business cycles. McGraw-Hill, New York.
Schwartz, S., Bardi, A. 1997. Influences of Adaptation to Communist Rule on Value Priorities in Eastern Europe. Political Psychology 18(2), 385-410.
Scott, WR. 1995. Institutions and Organizations. Sage Publications: Thousand Oaks, CA.
Scott, WR. 2008. Institutions and Organizations: Ideas and Interests. Sage Publications: 3rd ed. Thousand Oaks,

CA.
Shane, SA. 2000. Prior Knowledge and the Discovery of Entrepreneurial Opportunities. Organization Science 11(4), 448-469.
Shleifer, A. Vishny, R.W. 1998. The Grabbing Hand: Government Pathologies and their Cures. Cambridge, MA: Harvard University Press.
Simonen, J., McCann, P. 2008. Firm innovation: the influence of R&D cooperation and the geography of human capital inputs. Journal of Urban Economics 64 (1), 146–154.
Smallbone, D., Welter, F. 2001. The Distinctiveness of Entrepreneurship in Transition Economies. Small Business Economics 16(4): 249-262.
Smallbone, D., Welter F. 2006. Conceptualizing entrepreneurship in a transition context. International Journal of Entrepreneurship and Small Business 3(2), 190–206.
Sobel, RS. 2008. Testing Baumol: Institutional Quality and the Productivity of Entrepreneurship. Journal of Business Venturing 23(6), 641-655.
Stenholm, P., Acs, Z., Wuebker, R. 2010. Exploring Country-level Institutional Arrangements on the Rate and Type of Entrepreneurial Activity, Research Paper 2010-18, GMU School of Public Policy.
Stigler, G.J. 1971. The Theory of Economic Regulation, Bell Journal of Economics and Management Science 11, 3-21.
Stiglitz, J. 2002. Globalization and its discontents. The Penguin Press: New York.
Suchman, M. 1995. Managing Legitimacy: Strategic and Institutional Approaches. Academy of Management Review 20(3), 571-610.
Tan, H. W., Batra, G. 1995. Enterprise Training in Developing Countries, Incidence, Productivity Effects and Implications. Unpublished paper, the World Bank.
Thornhill, S. 2006. Knowledge, innovation and firm performance in high- and low-technology regimes. Journal of Business Venturing 21(5), 687-703.
vanStel, A, Storey, D, Thurik, R. 2007. The Effect of Business Regulations on Nascent and Young Business Entrepreneurship.S mall Business Economics 28, 171-186.
Verheul, I., Wennekers, S., Audretsch, DB., Thurik, R. 2002. An Eclectic Theory of Entrepreneurship, Policies, Institutions and Culture. In Entrepreneurship, Determinants and Policy in a European-U.S. Comparison, Audretsch D.B. Thurik R. Verheul I.Wennekers S. (eds). Kluwer: Academic Publishers, Norwell, MA, 11-82.
Vásquez-Urriago, R.A., Barge-Gil, A., Modrego, A., Paraskevopoulou, E. 2011. The impact of science and technology parks on firms´ product innovation: empirical evidence from Spain. MPRA, 2011.
UNECE 2010. Innovation Performance Review of Belarus report. (presented in Geneva, Dec. 2010, UNECE).
Wennekers, S., Wennekers, A., Thurik, R., Reynolds, P. 2005. Nascent Entrepreneurship and Economic Development. Small Business Economics 24(3), 293-309.
Wennekers, A, vanStel, A, Thurik A, Reynolds P. 2005. Nascent entrepreneurship and economic development. Small Business Economics 24, 293-309.
Welter, F., Smallbone, D. 2011. Institutional Perspective on Entrepreneurial Behaviour in Challenging Environments. Journal of Small Business Management 49(1), 107-125.
Williamson O. 1975. Markets and Hierarchies. Free Press: New York.
Williamson O. 1985. The Economic Institutions of Capitalism. Free Press: New York.
Williamson O. 2000. New institutional economics. Journal of Economic Literature 38, 595-613.
Wooldridge, J.M. 2002. Econometric Analysis of Cross Section and Panel Data. Cambridge: MIT Press.
Zahra, S. 1996. Technology strategy and new venture performance: a study of corporate-sponsored and independent. Journal of Business Venturing 11 (4), 289–321.
Zhuang, Y., Berkowitz, D., Bao, Y.-Q. 2009. Integrated effects on R&D composite input: China manufacturing firms practices. 2009 International Conference on Management Science and Engineering - 16th Annual Conference Proceedings, ICMSE 2009, 1739-1746
Zhuplev, A, Konkov, A, Kiesne, F. 1998. Russian and American small business: Motivations and obstacles. European Management Journal 16(4), 505-516.
Zucker, L. 1991. Postcript: Microfoundations of institutional thought. In The New Institutionalism in Organisational Analysis, Powell W. DiMaggio PJ (eds). University of Chicago Press: 103-106.