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Evidence for CESEE and FSU Countries

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Evidence for CESEE and FSU Countries

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Abstract

Due to information asymmetries between the debtor and potential outside investors, entrepreneurs often face sizeable and insurmountable financing constraints. This is a strong deterrent to either start new or continue already ongoing innovation projects which not only stymies entrepreneurs' own future innovation potentials and growth prospects but also severely harms growth potentials of whole economies, making catching-up an unnecessarily long and arduous process. Against this backdrop, the analysis sheds light on the effects of prevailing credit constraints on different innovation strategies (i.e. R&D-based make versus M&E-based buy strategies) of establishments in Central Eastern and South Eastern Europe (CESEE) and the Former Soviet Union (FSU) during three different economic phases. Results point to the detrimental effect of credit constraints which is particularly strong and consistent for the M&E-based 'buy innovation strategy' which dominates in the region but less pronounced and relevant for the less prevalent R&D-based 'make innovation strategy'. Furthermore, the analysis identifies firm characteristics that are conducive to innovative activities and demonstrates that establishment size, age, the particular international trading status, ownership status as well as whether subsidies were received are important determinants of different innovation strategies.

Keywords: credit constraints, R&D-based and M&E based innovation strategies, Central Eastern and South Eastern Europe, Former Soviet Union;

JEL classification: G21, O16, O31

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1. Introduction

It is well recognised that innovations are pivotal to economic outcomes. At the country level, innovations are considered one of the key engines of sustained economic growth which puts them high on the policy agenda of all industrialised countries, and increasingly also of developing countries that seek swifter technology-induced growth and more rapid catching-up with economically and technologically more advanced economies. Similarly, at the level of the individual firm, continuous efforts to develop new products and processes are considered crucial for firm survival and growth. In particular, as argued by Schumpeter (1934), successful innovators greatly profit from a temporary monopoly position which enables them to cream off substantial monopoly rents, at least until the swarming-effect of imitation sets in which steadily erodes innovators' monopoly position and rents.

Innovative activities are, however, costly and highly uncertain since costs are substantial, sunk and immediate while profits are medium- to long-term and technical and commercial success is extremely uncertain. In the absence of sufficient own internal resources, entrepreneurs often have to resort to capital markets to raise the necessary funds to finance their projects. Here, however, they often face sizeable and insurmountable financing constraints. In particular, since entrepreneurs typically know more about the quality of their projects than potential investors, the relationship between the debtor and potential outside investors is plagued by strong information asymmetries, leading to binding financing constraints and credit rationing by outside investors. However, given their potential detrimental effects on innovation and economic outcomes, binding financing constraints are a major concern for policy makers. In the face of sizeable and insurmountable financing constraints, innovators may feel discouraged to start new or continue ongoing innovation projects which not only undermines their own future innovation potentials and growth prospects but also negatively affects the economy as a whole. Specifically, this type of market failure results in underinvestment in R&D and machinery and equipment which curbs innovation efforts and outcomes, critically impairing economies' growth and development potentials, rendering catching-up an unnecessarily long and arduous process for developing countries.

However, the degree of financing constraints firms experience strongly depends on their own level of technological development which in turn determines the type of investment project and innovation strategy entrepreneurs pursue and request external funding for. In particular, as determined by their distance to the technological frontier, entrepreneurs apply *different innovation strategies* to develop technological innovations. As highlighted by Veugelers and Cassiman (1999), firms may (i) either invest in R&D to 'make' innovations in-house or indigenously if they are close to or at the technological frontier or (ii) may source externally and invest in machinery and equipment (M&E) and 'buy' technology and know-how embodied in machinery and equipment from the original innovator if they lag further behind the technological frontier but possess the necessary technological capabilities to absorb new embodied technological knowledge which they can transform into new or modified products or services. However, in contrast to entrepreneurs who pursue the 'buy' innovation strategy and invest in machinery and equipment to harness the embodied technological knowledge, this information asymmetry problem between debtor and potential outside investor – and consequently the existence and degree of funding constraints – is particularly acute for entrepreneurs close to or at the technological frontier who pursue

the 'make' innovation strategy and invest in R&D projects to develop innovations. In particular, in order to avoid quick imitation of their innovations, innovators are particularly reluctant to disclose crucial firm and project-specific information. These appropriability concerns compound any prevailing information asymmetry problems and result in stronger credit rationing of R&D projects relative to physical projects. Furthermore, as emphasised by Brown et al. (2010), debt-holders prefer physical assets as collateral while R&D creates an intangible asset (discounted uncertain future returns) which is difficult to collateralise, further compounding prevailing financing constraints for R&D innovators.

Against this backdrop, the ensuing analysis seeks to shed light on the role of binding financing constraints – in the form of credit constraints imposed by banks – for an entrepreneur's decision to realise innovation projects. In this respect, this study goes beyond the status quo of the literature, by looking at and comparing two different innovation strategies, namely the heavily researched R&D-based make strategy and the under-researched and widely neglected M&E-based buy strategy, and by determining how prevailing credit constraints affect the probability of entrepreneurs to pursue either of these two strategies. Furthermore, this study looks at a large set of transition economies, thereby adding to our understanding of the role of credit constraints in economically and technologically lagging economies. In particular, it uses data from the Business Environment and Enterprise Performance Survey (BEEPS) for a large set of Central Eastern and South Eastern European (CESEE) and Former Soviet Union (FSU) countries comprising Albania, Armenia, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, FYR Macedonia, Georgia, Hungary, Kosovo, Latvia, Lithuania, Moldova, Montenegro, Poland, Romania, Serbia, Slovenia, the Slovak Republic and Ukraine. Finally, this study takes a historical-comparative approach and sheds light on whether and how the role of credit constraints changed since the early 2000s. In particular, it looks at and compares results for three different economic phases which shaped the region in the last one and a half decades: (1) the phase of *'financial normalcy'* between 2000 and 2004, characterised by rapid economic growth, sizeable FDI inflows and growing money market and trade integration with the rest of the EU, (2) the '*bubble'* phase between 2004 and 2008, characterized by rapidly developing financial sectors in the region which helped fuel an unprecedented credit boom which culminated in the housing bubble and a sharp rise in private sector debt in a number of countries in the CESEE region, and (3) the '*crisis'* phase following the global financial crisis of 2008 which resulted in a temporary collapse of net capital flows to the region and a slump in trade and a partly dramatic slump in real GDP growth in a number of economies and soaring unemployment rates.

Methodologically, a recursive bivariate probit approach with endogenous credit constraints is applied. Generally, empirical findings point to the detrimental effect of prevailing credit constraints which, however, differs by innovation strategy and across economic phases analysed. Particularly, credit-constrained establishments are less likely to invest in R&D – but this only holds for the financial normalcy phase – while irrespective of economic phase considered, credit-constrained establishments are consistently less likely to invest in M&E. Since establishments in the CESEE region strongly rely on the M&E-based buy strategy to adopt new technologies and develop new products and processes, the consistent negative effect of credit constraints on M&E activities is particularly harmful for economies seeking quick technology-induced development and catching-up with technologically more advanced economies and calls for urgent policy action. Moreover, the analysis identifies firm characteristics which render either the make or the buy innovation strategy more likely, highlighting similarities but also differences across economic phases analysed. For instance, it relatively consistently shows across all three economic phases considered that larger establishments, internationally trading establishments and

establishments that received subsidies are more likely to invest in either R&D or M&E. By contrast, it provides evidence that during the crisis period establishments that are either part of a larger firm, majority foreign-owned or young are more likely to invest in M&E. During the bubble phase, however, establishments that are part of a larger firm are more likely to pursue R&D, while majority foreign-owned establishments are more likely to invest in M&E but less likely to pursue R&D. However, counter conventional wisdom, human capital plays a negligible role only for an entrepreneur's decision to invest in either R&D or M&E.

The rest of the paper is structured as follows: section 2 provides an overview of related empirical evidence which consistently demonstrates that financing constraints strongly deter investments, either in R&D activities or in machinery and equipment investments. Section 3 discusses data sources, some basic characteristics of firms in the sample and provides some descriptive evidence of the prevalence of innovators and M&E investors, on the one hand, and of credit constraints, on the other, in the sample. The methodological approach and variables used in the empirical analysis are discussed in section 4.1 while section 4.2 provides a detailed discussion of results for both innovators and M&E investors. Finally, section 5 summarises and concludes.

2. Related literature

Empirical evidence on the prevalence of credit constraints and their consequences is growing quickly. Following the seminal paper by Fazzari et al. (1988) an indirect, though controversial, approach to identifying financing constraints has become standard in this strand of literature. In essence, Fazzari et al. (1988) argue that firms' retention practices – such as low dividend payments – are reflective of the cost of external finance: in particular, if internal cash flow is insufficient to fully finance planned investment projects, firms may resort to paying low dividends to retain the better part of their income to fund projects. Hence, the sensitivity of investment to cash flow should thus be highest among high-retention firms. Methodologically, to shed light on the prevalence of financing constraints, samples of firms were divided according to a priori measures of financing constraints and observable investment-cash flow sensitivities were then analysed and compared across sub-samples. Greater investment-cash flow sensitivities were taken as evidence of stronger financing constraints. However, this approach was heavily criticised by Kaplan and Zingales (1997, 2000) who cast serious doubt on the fundamental underlying assumption that investment-cash flow sensitivities increase monotonically with the degree of financing constraints (Kaplan and Zingales, 1997) and stress that investment-cash flow sensitivities are bad indicators of financing constraints (Kaplan and Zingales, 2000).

Lately, however, more direct measures of the presence of financing constraints became available in many micro-level datasets which helped overcome obvious shortcomings of the investment-cash flow sensitivity approach and revived the discussion as to the presence and effects of financing constraints on firms' investment behaviour.

This quickly growing body of empirical literature finds consistent evidence that existing financing constraints strongly deter investment activities, either in terms of R&D projects or tangible (e.g. machinery and equipment) investment projects. For instance, with respect to the role of financing constraints for a firm's R&D activities, Männasoo and Meriküll (2011) use three consecutive rounds of the Business Environment and Enterprise Performance survey (BEEPs) between 2001 and 2007 for a larger set of economically more advanced Central and Eastern European transition economies and non-transition European countries. They demonstrate for the sample of Central and Eastern European economies that credit-constrained firms have an around 70 percentage points lower probability to conduct R&D. By contrast, however, no significant effect emerges for credit-constrained firms located in non-transition European economies. Similarly, Hajivassilou and Savignac (2008) use the survey 'Financement de l'Innovation Technologique' (FIT) together with the Banque de France Balance Sheet Dataset to shed light on direct as well as reverse effects between financing constraints and innovation. They demonstrate that binding financing constraints curtail innovation and that, simultaneously – probably due to the higher uncertainty and riskiness innovators face – innovative firms are also more likely to encounter binding financing constraints. Mohnen et al. (2008) use the Dutch Community Innovation Survey (CIS 3.5) to analyse the effects of financing constraints on a firm's probability to abandon, prematurely stop, seriously slow down, or not start an innovative project at all. They emphasise that almost every third innovative or potentially innovative firm in their sample felt hampered by one factor or another. Their results demonstrate that prevailing financing constraints significantly

increased the probability of prematurely stopping, seriously slowing down or not starting any innovation project at all, but had no significant effect on altogether abandoning innovation projects. Furthermore, they stress that prevailing financial constraints tend to reinforce – or, conversely, are reinforced by – other hampering financial and non-financial constraints which subsequently further increases the likelihood of abandoning, seriously slowing down or not starting any innovation projects. In a similar vein, Segarra et al. (2013) use data from the Spanish Technological Innovation Panel (PITEC) for the period 2004 to 2010 to analyse the role of financial obstacles for the probability to abandon an innovation project, differentiating by the particular stage of the innovation process, i.e. the concept stage as opposed to the realisation stage. In line with Mohnen et al. (2008) they demonstrate that financially constrained firms are generally more likely to abandon an innovation project. However, results stress that observable effects differ by the particular stage of the project: financial constraints only matter during the concept stage of a project but become insignificant once the project is on the way. Additionally, the analysis by Álvarez and Crespi (2011) suggests that the effects of financing constraints on a firm's innovative activities are independent of the level of economic development. They study a comprehensive sample of Chilean firms in 2007 and find conclusive evidence that innovative activities are less likely among financially constrained firms. Finally, Mancusi and Vezzulli (2010) use the 2004 Capitalia survey on Italian manufacturing firms to analyse the effects of financing constraints both, on the decision to conduct R&D as well as on the level of R&D investment. They find that the presence of financing constraints reduces the probability of doing R&D by around 23 per cent and also results in lower R&D investment levels. Moreover, their results emphasise that most of the negative effect of prevailing credit constraints stems from a firm's decision not to pursue R&D activities.

Furthermore, there is similar consistent evidence for the detrimental role of credit constraints on tangible investment projects. Hasan (2013) uses firm-level data from the 2006 and 2010 waves of the Latin American module of the World Bank Enterprise Surveys (WBES) for Argentina, Bolivia, Colombia, Peru, Mexico and Venezuela and demonstrates that firms that face credit constraints are significantly less likely to invest in capital goods (i.e., plant, machinery and equipment). Whether a deterioration of credit availability during the global financial crisis of 2008/09 affected a firm's probability to reduce investments in fixed assets is analysed by Hetland and Mjos (2012) for different types of fixed capital goods. The analysis uses data from a Financial Crisis Survey (FCS) conducted in Norway after the global financial crisis and demonstrates that the scale of credit constraints differs by type of fixed capital. In particular, the analysis shows that lower credit availability during the crisis increased the probability of a reduction in investments in plant, machinery and equipment by around 12 percentage points while lower credit availability during the crisis increased the likelihood of a reduction in investments in buildings by only around 8 percentage points. Related to that, Fauceglia (2013) uses firm-level data from the 2002 and 2005 waves of the World Bank's Enterprise Surveys (WBES) to shed light on the effects of credit constraints on the adoption of technology embodied in machinery and equipment for a large group of middle- and low-income countries. As technological laggards, firms located in developing countries can resort to adopting productivity-enhancing technologies embodied in machinery and equipment to improve firm performance and growth. Results highlight that credit-constrained firms see their probability of importing capital goods fall to almost zero, suggesting that in the face of credit constraints, technology-adoption almost comes to a standstill.

3. Data and descriptive analysis

3.1. DATA

The ensuing analysis uses data for a large set of Central Eastern and South Eastern European (CESEE) and Former Soviet Union (FSU) countries comprising Albania, Armenia, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, FYR Macedonia, Georgia, Hungary, Kosovo, Latvia, Lithuania, Moldova, Montenegro, Poland, Romania, Serbia, Slovenia, the Slovak Republic and Ukraine. The data were collected as part of the Eastern European component of the Business Environment and Enterprise Performance Survey (BEEPS) which is a joint initiative of the World Bank Group (WB) and the European Bank for Reconstruction and Development (EBRD). The Survey is based on interviews with firms in the manufacturing and services sectors, intended to provide an understanding of firms' perception of the environment in which they operate. It collects information on the quality of individual firms' business environment, how it is perceived by them and how it changes over time. It identifies various constraints or obstacles to firm performance and growth and captures the effects a country's business environment has on firms' international competitiveness. For the sake of better comparisons across countries, it follows a standard methodology. In particular, to obtain representative final samples and unbiased estimates for the whole population, each country-sample is selected using random sampling, stratified by establishment size (the following size-classes were used: small with 5 to 19 employees, medium with 20 to 99 employees, and large with more than 99 employees), region and business sector. From a sectoral perspective, all manufacturing sectors are covered, based on the ISIC revision 3.1 classification[1]. The primary sampling unit of each survey is the establishment with five or more full-time employees, located in major urban centres, which is engaged in non-agricultural activities.

All in all, 6.235 firms in the CESEE region were covered by the BEEPS-2005, 6.992 by the BEEPS-2009 and 7.590 by the BEEPS-2013 (see Annex Table A.1 for a more detailed overview by country). As for sample characteristics (see Annex Table A.2), the three country samples are dominated by small and medium-sized firms. In particular, between 40 and 60 per cent of all firms are small (with between 5 and 19 employees), around 30 per cent are medium-sized (with between 20 and 99 employees) while only between 12 and 25 per cent are large (with more than 99 employees). Furthermore, with less than 10 per cent, only a small fraction of all firms in the sample is either part of a larger firm or majority-foreign owned. On average, firms in the sample are around 15 years old. Finally, in terms of trading status, between 10 and 17 per cent of all firms are exporters only, between 4 and 13 per cent are importers only while between 7 and 15 per cent are both, exporters and importers. The remaining 60 to 75 per cent cater to domestic markets only and report no international trade relations whatsoever.

[1] The non-agricultural economy comprises all manufacturing sectors (ISIC rev.3.1: group D), the construction sector (ISIC rev.3.1: group F), the service sector (ISIC rev.3.1: groups G and H) as well as the transport, storage and communications sector (ISIC rev.3.1: group I).

3.2. PHASES

The analysis uses the 2005, 2009 and 2013 waves to analyse the role of binding funding constraints for investments in R&D, on the one hand, and machinery and equipment, on the other, during three different phases of economic and financial development in the region (see Table 1 for an overview). In this respect, the 2005 wave – which refers to fiscal year 2004 – will be used to study the phase of *'financial normalcy'* (between 2000 and 2004), characterised by a brief period of rapid economic growth, sizeable FDI inflows, growing money market and trade integration with the rest of the European Union, trade deepening as well as increasingly attractive housing markets in several economies which started to pull non-negligible investments in.

Table 1 / Three phases of economic and financial development

Phases	GDP growth	Money market	Trade	Innovation	Housing market
Financial normalcy (2000-04)	Rapid growth (GDP and GDP per capita) – relatively balanced investment and consumption expenditure	Sizeable FDI inflows Growing penetration of foreign banks Credit growth	Redirection of international trade flows – trade integration with EU Trade deepening	Reliance on FDI-based 'technology-transfer' model Development of indigenous technological capabilities	Housing market attracted investments
Bubble (2004-08)	Rapid growth (GDP and GDP per capita) – predominantly driven by private domestic consumption & real estate investment	Sizeable FDI inflows Rapid development of financial sector; Credit boom, Banks issue foreign currency-denominated loans	Strengthening of cross-border production networks (GVCs) Trade links among CESEECs strengthened	Reliance on FDI-based 'technology-transfer' model	Emergence of a housing bubble: *Superboom* (Baltics, Bulgaria), *Boom* (Poland, Slovakia, Slovenia, Czech Republic, Romania), *Strong increase* (Croatia, Hungary)
Crisis (2008 onwards)	Economic crisis: GDP growth negative or low, unemployment soared, investment and consumption slumped; Net capital flows collapsed (temporarily turned negative in some countries: e.g. Hungary, Estonia or Latvia)	Deceleration in credit and deposit growth Increase in non-performing loans Decline in profitability	Plunge in trade	Reliance on FDI-based 'technology-transfer' model Need to develop indigenous technological capabilities	Housing bubble burst, very slow recovery of real estate market

The 2009 wave, referring to fiscal year 2007, will be used to study the phase of the *'housing bubble'* (between 2005 and 2008), which is characterised by a rapidly developing financial sector – dominated by foreign banks – which provided easy access to affordable loans, thereby helping fuel an unprecedented credit boom which brought a sharp rise in private sector debt about and culminated in an

unprecedented housing bubble in several CESEECs. In particular, in the years leading up to the crisis, credit to the private sector increased rapidly in the CESEE region, particularly in Bulgaria, Estonia, Latvia, Lithuania and Romania (see Becker et al., 2010). As highlighted by e.g. Darvas and Szapáry (2008), both supply and demand side related factors fuelled the rapid pre-crisis credit growth process. On the supply side, the strong influx and dominance of foreign banks – particularly from the EU-15 – increased the banking sector's lending capacity but also increased competition among banks, which encouraged lending to the housing sector once the corporate sector was sufficiently saturated. On the demand-side, the drastic decline in real interest rates together with rapid output growth and a rise in future income expectations increased private agents' willingness to get into debt. Consequently, housing sectors in the region started to boom. However, as highlighted by Mihaljek and Subelyte (2013), different types of housing booms emerged in the CESEE region. In particular, in the Baltic countries as well as Bulgaria, a so-called *superboom* developed, characterised by annual growth rates in housing prices of more than 20 per cent between 2000 and the ultimate peak. In contrast, with somewhat lower annual growth rates of between 10 and 20 per cent, Poland, the Slovak Republic, Slovenia, the Czech Republic and Romania experienced a *'normal' boom*. Finally, housing booms were relatively moderate in Croatia and Hungary which both experienced *strong increases* in annual growth rates in housing prices of between 5 and 10 per cent only.

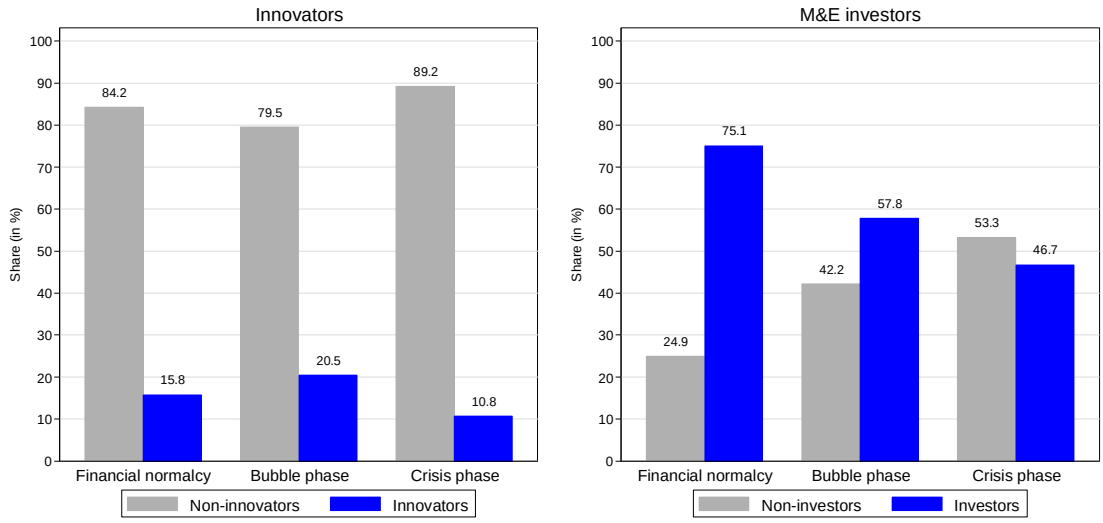
Finally, the 2013 wave – which refers to fiscal year 2011 – will be used to analyse the *'crisis phase'*, which was initiated by the global financial crisis which hit the region at the end of 2008. In fact, the crisis hit the region particularly hard. It put an end to the pre-crisis credit frenzy, brought housing bubbles to burst and eventually sent the housing market into meltdown. Furthermore, as a result of the crisis, net capital inflows into the region collapsed temporarily as due to liquidity-shortages in the home countries of subsidiaries of foreign banks in the CESEE region, capital flows into the region were disrupted and temporarily interrupted. This was further compounded by an exodus of other types of capital – particularly the most liquid type of investment such as portfolio investment and financial derivatives – initiated by more risk-conscious financial investors. Moreover, the region also suffered from a pronounced drop in export demand. Given the region's rapidly advancing economic integration prior to the crisis and its emergence as an important link in the globally increasing fragmentation of production value and supply chains, trade channels were strong so that the quickly spreading crisis and the plunge in global – but particularly EU-15 wide – demand reduced exports of goods and tradable services from the region. Together, the credit crunch and the drop in export demand resulted in a partly severe drop in real GDP growth in several economies in the region (the drop in real GDP growth was particularly strong in the Baltic countries, the former growth champions) and a dramatic increase in unemployment. Moreover, in the course of the crisis, banks experienced strong increases in non-performing loans and suffered sizeable losses in profitability as a large number of outstanding loans proved irrevocable. Hence, the global financial crisis has shaken the banking sector at its very core and fundamentally questioned its lax pre-crisis lending and credit allocation policies.

3.3. DESCRIPTIVE RESULTS

In line with Veugelers and Cassiman (1999), the ensuing analysis sheds light on the effects of prevailing credit constraints on different innovation strategies, namely (i) investments in R&D intended to produce technological innovations in-house or indigenously – referred to as 'make' strategy – and (ii) the acquisition of machinery and equipment (M&E) to buy technology and know-how embodied in machinery and equipment – referred to as 'buy' strategy – which enables M&E investors not only to profit from productivity improvements but also to develop new products or services or to modify existing ones. Establishments that pursue 'make' innovation strategies, either in-house or outsource (i.e. contracted with other companies and invest in R&D activities), will be referred to as 'innovators' while those that pursue 'buy' innovation strategies and invest in machinery and equipment (either used or new) to profit from embodied technology and productivity improvements will be referred to as 'M&E investors'.

The analysis uses a self-reported credit-constraint indicator (CC_{ijt}) to identify the prevalence and effect of prevailing credit constraints. In particular, firms are considered to be credit-constrained ($CC_{ijt} = 1$) if, in a particular fiscal year, they applied for any loans or lines of credit but the application was rejected by the bank. In contrast, $CC_{ijt} = 0$ if the firm successfully applied for a line of credit or loan.

Figure 1 / Prevalence of innovators and M&E investors during three different economic phases

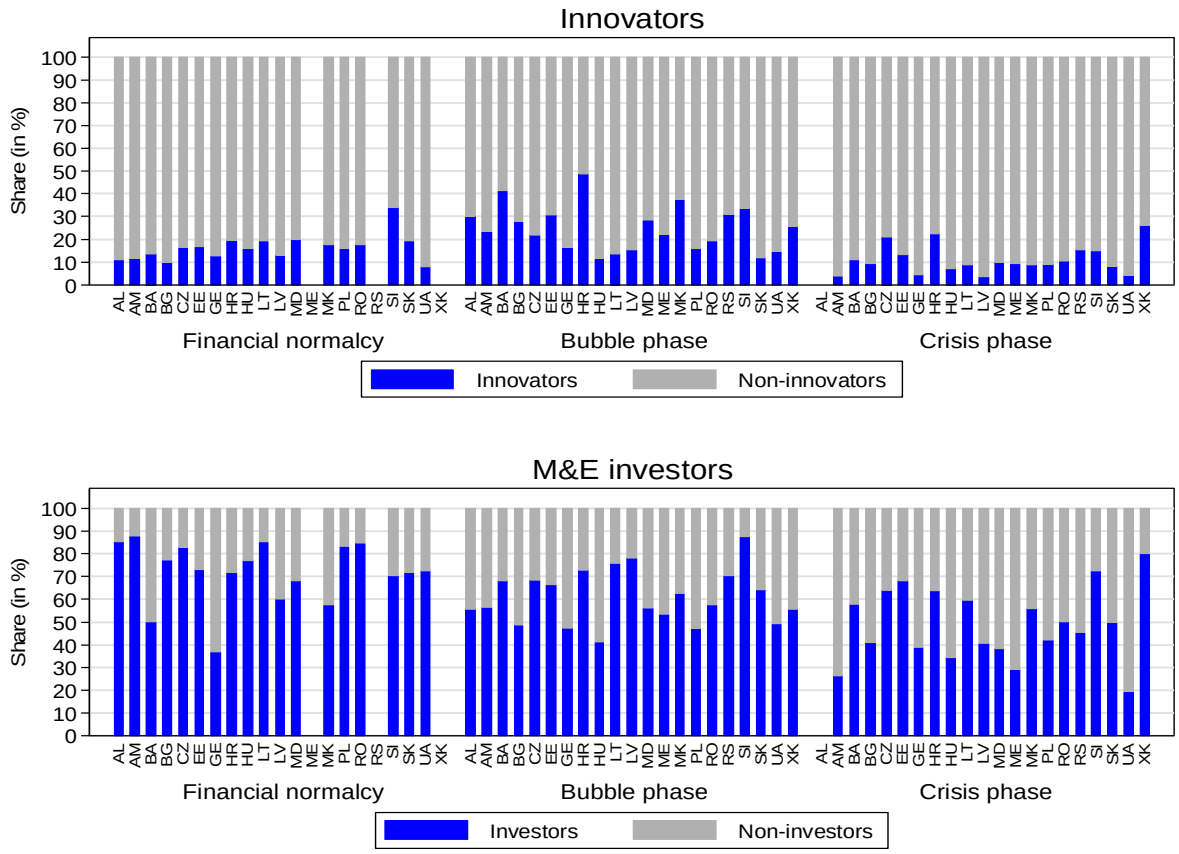


Source: BEEPS 2005, 2009 and 2013, own calculations.
Note: 'Innovator' refers to firms that invest in R&D while 'M&E investor' refers to firms that invest in machinery and equipment. 'Financial normalcy' refers to the period between 2000 and 2004, the 'Bubble phase' to the period between 2005 and 2008 while 'Crisis phase' refers to the period immediately after the financial crisis of 2008/09.

Figure 1 below depicts the prevalence of innovators and M&E investors during the three different economic phases under consideration. It highlights that R&D innovators (i.e. firms that report positive R&D expenditures) are a rather rare breed among CESEE and FSU countries, irrespective of the particular economic phase analysed. In particular, it shows that during the period of financial normalcy, only around 16 per cent of all firms spent on R&D activities (either in-house or outsourced), during the bubble phase, almost 21 per cent spent on R&D activities while probably as a result of the global financial crisis and the associated economic and financial uncertainty and decline, only around 11 per

cent spent on R&D activities. By contrast, investments in machinery and equipment are more frequent among firms in the region. During the period of financial normalcy, almost 75 per cent of all firms invested in machinery and equipment. During the bubble phase, M&E investors became less prevalent with only around 58 per cent which further declined to around 47 per cent during the crisis period when both demand and funding dwindled. Hence, by and large, Figure 1 suggests that in terms of innovation strategies establishments in CESEE and of the FSU predominantly pursue the 'buy' innovation strategy, which should put policies that encourage and facilitate technology adoption high on the political agenda of lagging economies in the region to accomplish higher growth and swifter catching-up.

Figure 2 / Prevalence of innovators and M&E investors during three different economic phases, by country



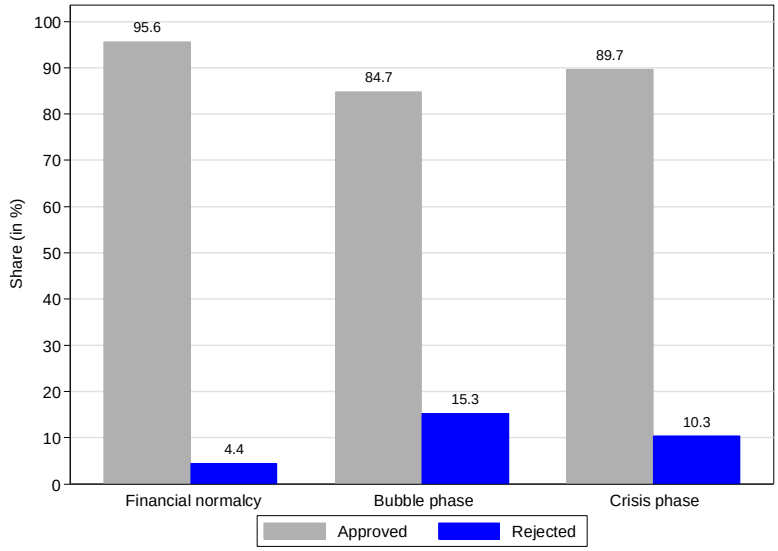
Source: BEEPS 2005, 2009 and 2013, own calculations.
Note: 'Innovator' refers to firms that invest in R&D while 'M&E investor' refers to firms that invest in machinery and equipment. 'Financial normalcy' refers to the period between 2000 and 2004, the 'Bubble phase' to the period between 2005 and 2008 while 'Crisis phase' refers to the period immediately after the financial crisis of 2008/09. The following country codes are used: AL (Albania), AM (Armenia), BA (Bosnia and Herzegovina), BG (Bulgaria), CZ (Czech Republic), EE (Estonia), GE (Georgia), HR (Croatia), HU (Hungary), LT (Lithuania), LV (Latvia), MD (Republic of Moldova), ME (Montenegro), MK (FYR Macedonia), PL (Poland), RO (Romania), RS (Serbia), SI (Slovenia), SK (Slovak Republic), UA (Ukraine) and XK (Kosovo).

The prevalence of R&D innovators (top panel) as well as M&E investors (bottom panel) during the three different economic phases under consideration is depicted in Figure 2 for each individual country in the sample separately, which points to pronounced heterogeneity across countries and economic phases. It shows that during financial normalcy, the prevalence of innovators was highest in Slovenia (with around

35 per cent), followed by Moldova, Croatia, Slovakia and Lithuania (with almost 20 per cent) and Macedonia and Romania (with almost 18 per cent). By contrast, the share of innovators was lowest in Ukraine and Bulgaria (with less than 10 per cent). During the bubble phase, however, innovators were generally more prevalent in all economies in the sample. Moreover, shares of innovators were also more diverse, reaching as high as 49 per cent and as low as 11 per cent. In particular, with almost 50 per cent, the share of innovators was highest in Croatia, followed by Bosnia and Herzegovina (with around 41 per cent) and Macedonia and Slovenia (with around 37 and 31 per cent, respectively). In contrast, with less than 12 per cent, Hungary was the bottom of the league. During the crisis period, innovators became less prevalent and the share of innovators became less diverse and ranged between 3 per cent only in Latvia and 26 per cent in the Kosovo. More specifically, with over 20 per cent the share of innovators was highest in the Kosovo, followed by Hungary and the Slovak Republic and with less than 5 per cent, it was lowest in Latvia (with around 3 per cent), followed by Armenia, Ukraine and Georgia.

Similarly, in terms of M&E investors, the bottom panel in Figure 2 again points to the non-negligible heterogeneity across countries and economic phases. In particular, during the phase of financial normalcy, the share of M&E investors in the economy ranged between 37 per cent in Georgia only and almost 90 per cent in Armenia. In particular, with over 80 per cent, the share of M&E investors was highest in Armenia, Albania, Lithuania, Romania, Poland and the Czech Republic and with below 60 per cent, it was lowest in Georgia (with 37 per cent), followed by Bosnia and Herzegovina and Macedonia. The spread in the shares of M&E investors was lower during the bubble phase. More specifically, the share of M&E investors was highest in Slovenia, with almost 90 per cent, followed by Latvia with around 78 per cent and Lithuania and Croatia with almost 75 per cent. By contrast, with around 41 per cent, it was lowest in Hungary. Finally, a more diverse picture emerges during the crisis phase when the share of M&E investors reached as high as 80 per cent in Kosovo, followed by Slovenia with almost 75 per cent and Croatia, the Czech Republic and Lithuania with between 63 and 68 per cent. With less than 30 per cent, Ukraine, Armenia and Montenegro were the bottom of the league.

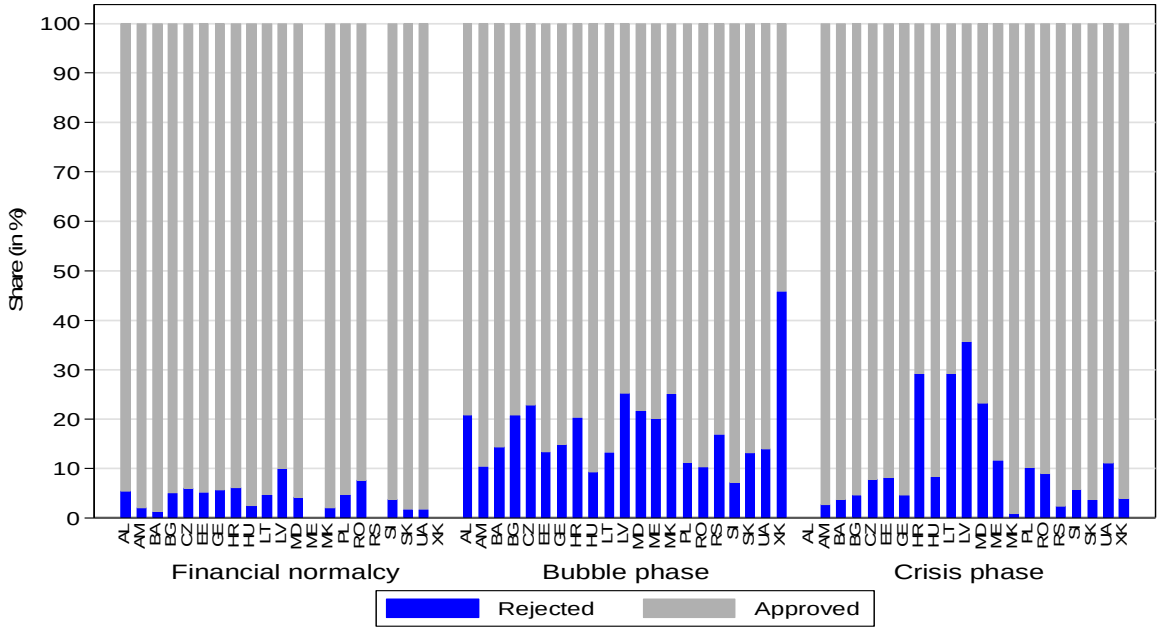
Figure 3 / Frequency of credit constraints during three different economic phases



Source: BEEPS 2005, 2009 and 2013, own calculations.
Note: 'Financial normalcy' refers to the period between 2000 and 2004, the 'Bubble phase' to the period between 2005 and 2008 while 'Crisis phase' refers to the period immediately after the financial crisis of 2008/09.

Furthermore, Figure 3 sheds light on the frequency of credit constraints firms encounter when applying for bank loans or credits. It demonstrates that the rejection of a credit application was generally a rather rare incidence. Moreover, it shows that the frequency of rejections differed across economic phases analysed. In particular, during the phase of financial normalcy, only around 5 per cent of all credit applications were rejected by banks. However, during the bubble phase, the rejection of a bank application became a more prevalent incident and almost tripled to around 15 per cent. During the crisis period, however, credit rejections went down again to around 10 per cent, despite the dire economic and financial situation in many economies in the region.

Figure 4 / Frequency of credit constraints during the three different economic phases, by country

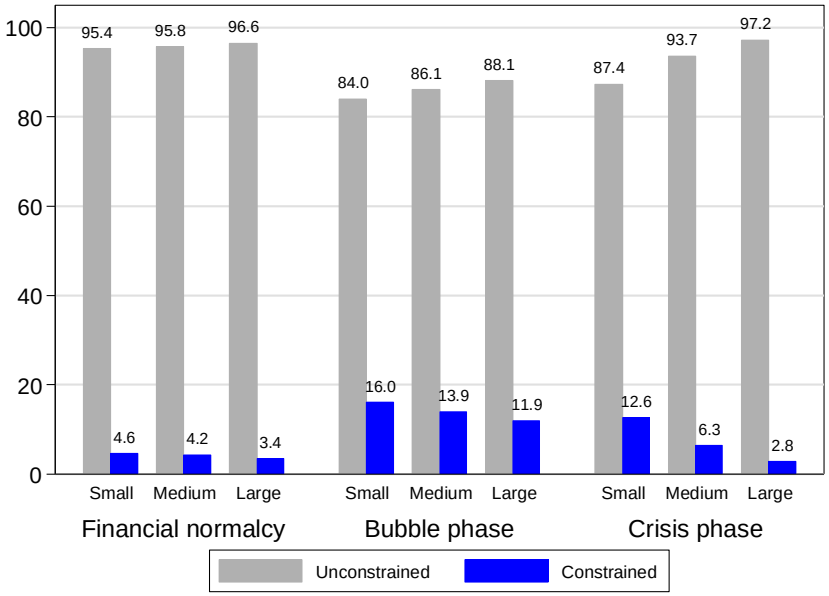


Source: BEEPS 2005, 2009 and 2013, own calculations.
Note: 'Financial normalcy' refers to the period between 2000 and 2004, the 'Bubble phase' to the period between 2005 and 2008 while the 'Crisis phase' refers to the period immediately after the financial crisis of 2008/09. The following country codes are used: AL (Albania), AM (Armenia), BA (Bosnia and Herzegovina), BG (Bulgaria), CZ (Czech Republic), EE (Estonia), GE (Georgia), HR (Croatia), HU (Hungary), LT (Lithuania), LV (Latvia), MD (Republic of Moldova), ME (Montenegro), MK (FYR Macedonia), PL (Poland), RO (Romania), RS (Serbia), SI (Slovenia), SK (Slovak Republic), UA (Ukraine) and XK (Kosovo).

In a similar vein, Figure 4 shows the frequency of credit constraints during the three economic phases for each country separately. It highlights that the prevalence of credit constraints was very low during the phase of financial normalcy where the share of firms that experienced credit constraints ranged between 1 and 10 per cent only. In particular, the incidence of credit constraints was lowest in Bosnia and Herzegovina, where only around 1 in every 100 credit applicants received a rejection, followed by the Slovak Republic, Ukraine, Armenia and Macedonia, where only around 2 in every 100 credit applicants received a rejection. In contrast, credit constraints were highest in Latvia, where every 10th applicant saw his or her credit application rejected. However, credit constraints became more prevalent during the bubble phase and reached as much as 46 per cent in Kosovo, indicating that almost every 2nd credit application was rejected, and 22 per cent in Croatia, suggesting that every 4th application was rejected. Credit constraints were least prevalent in Slovenia, Hungary, Armenia and Romania where only every

10th credit applicant saw his or her credit application rejected. Finally, during the crisis phase, credit constraints were generally lower than in the pre-crisis bubble phase in all countries but Croatia, Lithuania, Latvia and Moldova, which all had exceptionally high rejection rates of between 30 and 40 per cent. These surprisingly low rejection rates during the crisis phase are partly a result of the generally lower application rates (of only around 25 per cent) during this period, paired with the probably stronger self-selection of more viable and promising applications. With a rejection rate of only 1 per cent, credit constraints were least prevalent in Macedonia, followed by Serbia, Armenia, the Slovak Republic and Bosnia and Herzegovina with rejection rates of below 4 per cent.

Figure 5 / Frequency of credit constraints during the three different economic phases, by firm size



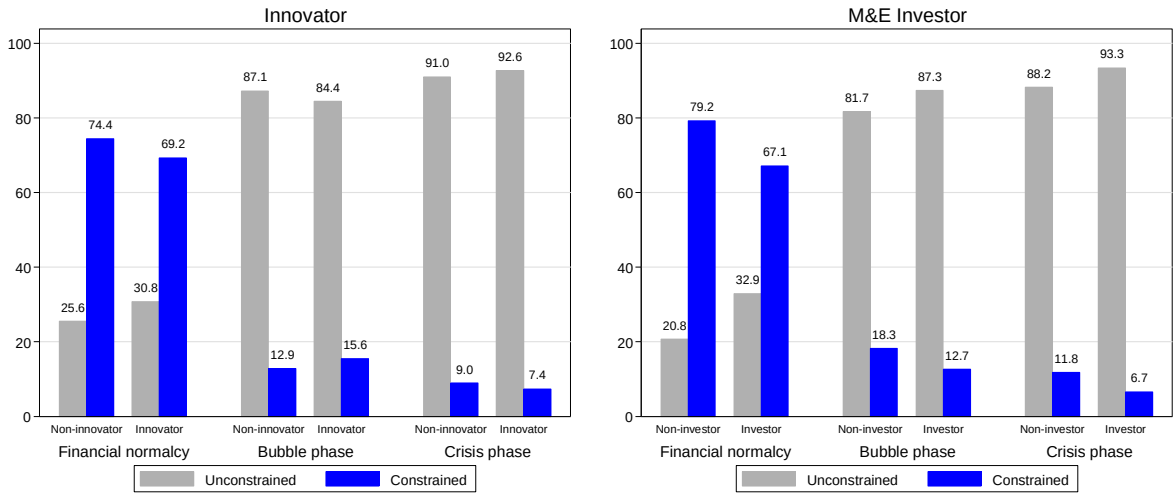
Source: BEEPS 2005, 2009 and 2013, own calculations.
Note: 'Financial normalcy' refers to the period between 2000 and 2004, the 'Bubble phase' to the period between 2005 and 2008 while 'Crisis phase' refers to the period immediately after the financial crisis of 2008/09.

Furthermore, as highlighted above (see section 2), firm size plays a pivotal role for the success of bank credit application processes. Hence, Figure 5 below depicts the prevalence of credit constraints by firm size and demonstrates that small firm size is a serious disadvantage in bank credit application processes. Specifically, it demonstrates that irrespective of the economic phase considered, smaller firms are more likely to be credit-constrained than larger ones. However, the size-related disadvantage appears most pronounced during the crisis period where 13 per cent of all small firms experienced a rejection of their credit application. In contrast, only 7 per cent of medium-sized firms and around 3 per cent of large firms faced a rejection of their bank loan applications.

Finally, Figure 6 depicts the frequency of credit constraints during the three different economic phases by type of innovator (i.e. R&D innovator versus M&E investor). It highlights that the frequency of credit constraints differs by type of innovator as well as by the particular economic phase considered. In particular, R&D innovators are more likely to face credit constraints than non-innovators during the bubble phase only. In both the period of financial normalcy and the crisis non-R&D innovators are more likely to experience credit constraints. This indicates that during these two economic phases, credit

constraints render firms less likely to be innovative and invest in R&D. This is in contrast to M&E investors who are consistently less likely to face credit constraints than non-M&E investors, irrespective of the particular economic phase considered which suggests that prevailing binding credit constraints render firms less likely or inclined to invest in machinery and equipment.

Figure 6 / Frequency of credit constraints during the three different economic phases, by type of innovator



Source: BEEPS 2005, 2009 and 2013, own calculations.
Note: 'Innovator' refers to firms that invest in R&D while 'M&E investor' refers to firms that invest in machinery and equipment. 'Financial normalcy' refers to the period between 2000 and 2004, the 'Bubble phase' to the period between 2005 and 2008 while 'Crisis phase' refers to the period immediately after the financial crisis of 2008/09.

4. Credit constraints and the propensity to innovate or invest

4.1. METHODOLOGICAL APPROACH

To shed light on the role of prevailing credit constraints for a firm's decision to pursue different innovation strategies, a recursive bivariate probit model with endogenous credit constraints is applied. The potential endogeneity of the credit constraint indicator stems from two different sources: Firstly, latent heterogeneous factors (such as entrepreneurial behaviour) may affect both the probability of being credit-constrained and the probability of being an innovator or M&E investor. Secondly, the decision to pursue innovative activities and how to finance them – i.e. by means of internal or external sources – may be simultaneous.

The recursive system is specified as follows:

$$PI_{ijt} = \begin{cases} 1 \;\; if \;\; PI^*_{ikt} = \alpha_1 CC_{ijt} + \beta_1 FC_{ijt} + \beta_2 ID_{ijt} + \beta_3 C_{jt} + \epsilon_{ijt} > \bar{a} \\ 0 \;\; if \; PI^*_{ijt} = \alpha_1 CC_{ijt} + \beta_1 FC_{ijt} + \beta_2 ID_{ijt} + \beta_3 C_{jt} + \epsilon_{ijt} \leq \bar{a} \end{cases} \quad (1)$$

$$CC_{ijt} = \begin{cases} CC^*_{ijt} = \gamma_1 FC'_{ijt} + \gamma_2 ID_{ijt} + u_{ijt} & if \;\; CC^*_{ijt} > 0 \\ 0 & if \;\; CC^*_{ijt} = 0 \end{cases} \quad (2)$$

where equation (1) is the outcome equation that explains the probability that a firm is an innovator while equation (2) is the structural equation that specifies the probability that a firm is credit-constrained. Moreover, PI^*_{ijt} and CC^*_{ijt} are latent variables, while PI_{ijt} and CC_{ijt} are dichotomous variables such that PI_{ijt} takes the value 1 if firm i in country j at time t decides to invest in R&D or to acquire M&E, provided its R&D and M&E expenditures exceed a particular threshold $\bar{a}$ and 0 otherwise. Moreover, $CC_{ijt} = 1$ if $CC^*_{ijt} > 0$ and $CC_{ijt} = 0$ otherwise.

In equation (1), the analysis differentiates between two different types of investment activities/innovation strategies: (1) *R&D activities* performed in-house ($PI_{ijt} = INNOV_{ijt}$) on the one hand to capture the 'make' strategy and (2) *machinery and equipment investment activities* ($PI_{ijt} = MEI_{ijt}$) on the other to capture the 'buy' strategy. Moreover, CC_{ijt} in equation (2) is a self-reported credit-constraint indicator which is equal to 1 if in a particular fiscal year, a firm applied for any loans or lines of credit but experienced a rejection by the bank and zero if the firm successfully applied for a line of credit or loan. In addition, as highlighted above, the analysis looks at three different economic phases ($t = 1, 2, 3$): (1) '*financial normalcy'* (referring to the period between 2000 and 2004), (2) the phase of the *'housing bubble'* (referring to the period between 2005 and 2008), and (3) the *'crisis phase'* (referring to period immediately after the onset of the global financial crisis of 2008/09).

For the purpose of identification, the error terms are assumed to be independently and identically distributed as bivariate normal as follows:

$$\begin{pmatrix}\epsilon_{ikt}\\ u_{ikt}\end{pmatrix} \sim IID\left(\begin{bmatrix}0\\0\end{bmatrix}, \begin{bmatrix}1 & \rho\\ \rho & 1\end{bmatrix}\right),$$

where $\rho = Cov(\epsilon_{ikt}, u_{ikt})$.

FC_{ikt} in equation (1) is a vector of different firm characteristics, comprising the following:

Firm size is included to account for the role of size for different innovation activities. In particular, following Schumpeter (1942), larger firms are assumed to be more innovative than smaller ones, either as a result of capital market imperfections which leave small firms with insufficient internal resources to fund innovative activities or, as advocated by Cohen and Klepper (1996), due to the higher level of output which renders larger firms able to produce more output and allows them to more easily average fixed costs of R&D over a greater level of output so that R&D efforts tend to increase with output and firm size. Related empirical evidence seems to support Schumpeter's size-innovation hypothesis, highlighting that smaller firms have a significantly lower probability to perform R&D than larger ones (see, e.g., Mancusi and Vezzulli, 2011; Hajivassilou and Savignac, 2008; Männasoo and Meriküll, 2011). However, as shown in the study by Álvarez and Crespi (2011) on Chilean firms, this size-effect is not universal. In the ensuing analysis, firm size is captured by three size-related dummy variables, namely a dummy for medium-sized firms (with between 20 to 99 employees) and large firms with more than 99 employees, separately. The group of small firms with between 5 and 19 employees represents the reference group.

Firm age is included to test whether and how age affects the probability of pursuing a particular innovation strategy. However, the age-effect is unclear a priori. On the one hand, due to non-negligible learning-by-doing effects which materialise over time, processes become more efficient, routinised and cost-efficient, and firms tend to become more innovative. On the other hand, however, age may render knowledge and skills obsolete as successful routines permanently permeate the firm's organisation, rendering it inflexible and rigid and unresponsive to frequently changing market conditions (Agarwal and Gort, 2002). Similarly, as advocated by Schumpeter (1934), new entrants are vital sources of novel and technologically superior products and processes, rendering younger firms more likely to innovate. Empirically, the role of firm age for innovative activities is shown to be a complex one. For instance, Huergo and Jaumandreu (2004) demonstrate for a representative sample of Spanish manufacturing firms that the propensity to innovate changes non-linearly with firm age. In particular, entering firms show a relatively high propensity to innovate. The probability to innovate decreases in maturing firms, reaches an all-time low at the age of about 18 to 20 years and again increases thereafter. Furthermore, the oldest firms and exiting firms are characterised by a somewhat lower propensity to innovate than entrants in their first years. To test for the role of age for a firm's strategies, a dummy for 'young' is included for firms younger than 5 years where age is defined as the difference between the current fiscal year and the year the firm started its operations.

In addition, a firm's ***ownership status*** is also decisive for its ability to pursue innovative efforts. In particular, owing to easier access to knowledge, human resources and internal funds paired with more efficient and widespread risk-diversification strategies, innovative efforts may be higher among firms that

are both part of a group and foreign-owned. With respect to business-group affiliation, empirical evidence shows little consensus, however, pointing to either insignificant effects (see, e.g., Conceição and Heitor, 2005 for Portuguese firms or Chudnovsky et al., 2006 for Argentinian manufacturing firms) or positive effects (see, e.g., Crespi et al., 2014 for a large set of Latin American countries or Hagén et al., 2007 for Swedish firms). In the ensuing analysis, a dummy variable for *business-group affiliation* is included for firms that are part of a group to test the hypothesis that internal capital markets render access to internal resources easier for firms that are part of a group, which can therefore more easily acquire the necessary resources and knowledge to pursue innovative activities. The dummy is equal to 1 if an establishment is part of a larger group, and zero otherwise. On the other hand, a dummy variable for *majority foreign ownership* is included to test whether foreign owned firms enjoy easier access to know-how and human resources and therefore benefit from knowledge transfer, which materialises in stronger innovative efforts. Empirically, however, foreign-ownership seems to matter little only for a firm's propensity to innovate (see, e.g., Mancusi and Vezzulli, 2011; Männasoo and Meriküll, 2011; Chudnovsky et al., 2006). A dummy variable for majority foreign ownership is included which is equal to 1 if more than 50 per cent of an establishment is owned by private foreign individuals, companies or organisations, and zero otherwise.

Furthermore, innovative efforts of an establishment also depend on its ***trading status*.** In particular, firms that trade products and services internationally also encounter fiercer competition which encourages them to invest in R&D to maintain or even gain a leading edge over their competitors. Moreover, internationally trading firms also benefit from their exposure to international technology and the ensuing technology transfer that may take place. Similarly, foreign capital goods markets are key sources for productivity-enhancing leading-edge machinery and equipment, particularly for technologically lagging economies with underdeveloped, dysfunctional or altogether lacking capital goods markets. Hence, internationally trading firms may have a higher propensity to innovate and, due to better information about the availability of as well as better access to foreign embodied and disembodied technology, may also exert higher R&D efforts. Generally, empirical evidence points to a positive correlation between exporting on the one hand and innovative efforts on the other (see, e.g., Männasoo and Meriküll, 2011).[2] For the ensuing analysis, internationally trading firms are captured in terms of three dummy variables. A dummy variable for *exporters only* is included which is equal to 1 if an establishment reports positive sales from direct exporting activities but no expenditures from directly importing inputs, and zero otherwise. Moreover, a dummy variable for *importers* only is included which is equal to 1 if an establishment directly imported material inputs and supplies of foreign origin, and zero otherwise. Finally, a dummy variable for *exporters and importers* is included which is equal to 1 if an establishment both directly exports goods and services and imports material inputs and supplies, and zero otherwise.

A firm's innovative efforts may also be affected by the gender of the top manager. Little is generally known about the intersection of gender, entrepreneurship and innovation. However, Strohmeyer and Tonoyan (2008) suggest that due to occupational sex-segregation which results in the higher presence of women in less technical or technology-oriented occupations, renders female-owned enterprises also less committed to and less likely to perform both product and process innovations. This negative gender-

[2] Furthermore, more recent empirical evidence sheds light on the causal relationship between firm innovation on the one hand and firm export activity on the other and suggests that while innovating status increases the probability of exporting it does not necessarily increase the probability of becoming a first time exporter (Damijan and Kostevc, 2008 or Palangkaraya 2012).

effect is captured by a dummy variable for ***female***, which is equal to 1 if an establishment's top manager is female, and zero otherwise.

Moreover, whether an establishment receives any sort of ***public financial support*** may also prove vital for its willingness or ability to pursue innovative activities. More specifically, some innovative activities – such as the make strategy analysed is this paper – are particularly uncertain and costly which renders additional financial support pivotal to a firm's innovative efforts and, potentially, success. Generally, government intervention to support innovative activities is seen as a measure to correct for prevailing market failures stemming from the incomplete appropriability of the outcome of research endeavours which results in under-investment in innovation, thereby not only cubing innovation success but also impairing growth potentials and slowing down catching-up processes of lagging economies. Empirically, however, there is little consensus as to the effectiveness of government intervention programmes in fostering innovation (see Capron and Van Pottelsberghe, 1997 for a review of results). To test for the role of government intervention programmes, the variable *subsidy* is included which is equal to 1 if an establishment received any subsidies from the national, regional or local government or the European Union, and zero otherwise.

Furthermore, there is consistent evidence that the endowment of firm-specific human capital is pivotal to any innovative efforts and success. For instance, more ***human-capital*** rich firms are shown to have a higher propensity to innovate (see, e.g., Janz et al., 2003) or the lack of qualified personnel is found to significantly reduced the propensity to innovate among firms (see, e.g., Silva et al., 2008). Hence, to account for the key role of skills for innovation activities, the percentage of an establishment's labour force with a university degree is used in the analysis.

ID_{ikt} is a vector of ***industry dummies*** comprising mining, construction, manufacturing, transport, wholesale and retail trade, real estate, hotels and restaurants, and other services.

C_{kt} captures ***country characteristics*** included in the analysis and refers to ***real GDP growth rate*** to test whether establishments that are located in faster growing economies have richer internal resources at hand and therefore more strongly pursue innovative activities.

The credit-constrained equation (2) controls for the following firm and country characteristics: ***firm size, firm age, business-group affiliation, majority foreign-ownership, exporter only, importer only, exporter and importer*** and ***female***, all as defined above. Furthermore, the log of sales per employee is used as an exclusion restriction. It refers to the ***log of sales per employee*** (in Euro) and captures an establishment's endowment with internal resources which is expected to render access to external funding, such as bank credits, easier and credit constraints less likely since more collateral is available for the bank to liquidate in the event of bankruptcy and foreclosure.

Furthermore, a number of additional country-level variables are included to capture the state or the structure of the banking sector, which prove pivotal to a firm's access to bank loans. Generally, a healthy banking sector which relies on stringent risk assessment procedures to approve credits and is therefore relatively unburdened by non-performing loans (NPL) may be more willing to approve credit applications. In the analysis, the state of the banking sector is captured by the ***ratio of bank non-performing loans to total gross loans***. Likewise, the general willingness of the banking sector to provide credits is essential for an establishment's access to bank credits. An establishment has good chances of having a

credit application approved if the banking sector provided non-negligible domestic credits in the past. In the analysis, this is captured by ***domestic credit provided by banking sector*** (in % of GDP). Similarly, the ease of accessing financial services matters also for an establishment's success in applying for a credit. In particular, a high geographical ***outreach*** of formal financing services captured in terms of a strong penetration of commercial bank branches makes the physical access to banks easier for firms seeking bank loans. In this respect, the number of branches of commercial banks per 100,000 adults, which reflects the average number of people served by each branch, is used as a proxy for banking sector outreach and as an indicator for the ease of physically accessing banking services.

Finally, ID_{ikt} is again a vector of ***industry dummies***, comprising construction, manufacturing, transport, wholesale and retail trade, real estate, hotels and restaurants, and other services.

For summary statistics and correlation matrices see Table A.2 to Table A.5 in the Annex.

4.2. RESULTS

4.2.1. Innovators

Table 2 and Table 3 below report results of the analysis for each of the three economic phases of interest separately. In particular, results in Table 2 refer to R&D innovators and identify the particular set of determinants that render an establishment more likely to pursuing R&D-based 'make' innovative activities, explicitly accounting for the endogenous nature of credit constraints. While columns (1), (3) and (5) identify determinants of a rejection of a bank credit application, columns (2), (4) and (6) identify firm and country characteristics that render an establishment more likely to be an R&D innovator.

In line with similar analyses (e.g., Männasoo and Meriküll, 2011; Álvarez and Crespi, 2011; Mancusi and Vezzulli, 2010), there is evidence that credit-constrained establishments are less likely to innovate. This, however, only holds during the financial normalcy phase when credit-constrained establishments are around 21 percentage points less likely to pursue innovative activities than unconstrained ones. By contrast, no significant effects emerge for either the bubble phase or the crisis phase, suggesting that during these two phases constrained and unconstrained firms had similar probabilities of pursuing innovative activities.

Moreover, results demonstrate that large establishment size is an advantage, both for a successful bank credit application as well as for being an innovator. In particular, during the crisis period, larger establishments were significantly less likely to face credit constraints. This negative size-constraint nexus also consistently emerges in similar studies by Beck et al. (2006), Angelini and Generale (2005), Hadlock and Pierce (2010) or Winker (1999), to name but a few. In addition, our results confirm Schumpeter's 'size-innovation' hypothesis and consistently demonstrate that larger establishments are more likely to innovate than small ones. However, the size of the effect differs by particular economic phase under consideration: during the phase of financial normalcy, large establishments were almost 20 percentage points more likely than small ones to be innovative, during the bubble phase large establishments were only 16 percentage points more likely to be innovative while during the crisis phase

large establishments were only 12 percentage points more likely to pursue innovative activities than small ones.[3]

By contrast, irrespective of economic phase considered, there is little evidence in support of Schumpeter's assertion that younger firms or entrants are more likely to innovate. However, in line with findings of e.g. Beck et al. (2006), Winker (1999) or Ferrando and Mulier (2013), young age proves disadvantageous for credit application processes. In particular, except for the financial normalcy phase, young firms are around 5 to 6 percentage points more likely to face credit constraints than older firms. The apparent disadvantage of young age for successful credit application processes may be due to young firms' lacking reputation and credit history with banks together with their still insufficient business experience which renders them more prone to failure and bankruptcy and therefore too risky to provide sizeable credits to.

Furthermore, in line with related empirical evidence (e.g. Crespi et al., 2014; Hagén et al., 2007) our results demonstrate that an establishment's ownership status matters, to a limited degree though. In particular, except for the crisis phase, establishments that are part of a larger firm are more likely to pursue innovative activities (by between 8 and 9 percentage points). However, similar to e.g. Shin and Park (1999), Schiantarelli and Sembenelli (2000) or Beck et al. (2006), we do find evidence of the internal-market hypothesis which postulates that the existence of internal capital markets renders access to financing easier for firms that are part of a larger firm. These firms can therefore more easily resort to either internal funds to repay their loans or credits or access larger assets to liquidate their debts which renders them more credit worthy and less likely to face binding constraints. Similarly, somewhat unexpectedly and in contrast to related empirical evidence, majority foreign-owned establishments are found to be less likely to pursue innovative activities. But this only holds during the bubble phase, where majority foreign-owned establishments were almost 7 percentage points less likely to be innovative. This finding may indicate that majority foreign-owned establishments in the region predominantly serve as production units, putting less emphasis on R&D and innovation. Furthermore, results reject the internal-market hypothesis for majority foreign-owned firms which that are expected to enjoy easier access to funding due to the existence of internal funds or capital markets. Particularly, majority foreign-owned firms were actually more likely to face credit constraints. But this finding is limited to the crisis phase only and could point to discriminatory practices of banks during economically difficult times in favour of domestic firms.

By contrast, there is a strong role of an establishment's trading status for its probability to innovate. In particular, except for the financial normalcy phase which is characterised by growing trade integration with the rest of the EU but very low innovative activities of firms, we find consistent evidence that internationally trading firms are more likely to pursue innovative activities than firms that source from and cater to domestic markets only. Moreover, our results point to a consistent ranking: establishments that both export and import are most likely to innovate (by between 7 and 22 percentage points); followed by establishments that import only (which were around 11 percentage points more likely to pursue innovative activities); finally, exporters only were the bottom of the league and were only between 6 and 8 percentage points more likely to innovate than establishments that cater to domestic markets only. These findings seem to suggest that exporting and importing firms which face fierce competition in

[3] T-tests point to significantly different firm-size effects across economic phases, rendering the size-effect of the financial normalcy phase significantly different from the bubble phase (p=0.000) and the crisis phase (p=0.001). No significant differences are observable between the bubble phase and the crisis, however (p=0.736).

international markets but also enjoy easier access to foreign knowledge and technology which can be harnessed to develop new products and processes indigenously have the strongest incentive to innovate. Furthermore, importing firms only appear to benefit greatly from access to foreign knowledge and (embodied or disembodied) technology which renders them also more likely to innovate while exporters only which compete internationally but have a harder time tapping into international knowledge and technology to develop technological novelties are relatively least likely to innovate.

Table 2 / Determinants of the probability to innovate, by economic phase

	Financial normalcy		*Bubble phase*		*Crisis phase*	
	Rejected (yes=1)	Innovator (yes=1)	Rejected (yes=1)	Innovator (yes=1)	Rejected (yes=1)	Innovator (yes=1)
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Credit-constrained		-0.212***		0.261		0.289
		(-2.47)		(1.23)		(1.43)
Medium-sized	-0.001	0.088***	-0.029	0.066***	-0.045***	0.043**
	(-0.07)	(5.60)	(-1.51)	(2.67)	(-2.90)	(2.01)
Large	-0.003	0.193***	-0.030	0.161***	-0.109***	0.117***
	(-0.12)	(9.67)	(-1.41)	(5.74)	(-4.03)	(4.43)
Young	0.004	-0.004	0.040*	-0.018	0.045**	-0.029
	(0.28)	(-0.22)	(1.75)	(-0.55)	(2.27)	(-0.85)
Part of a larger firm	-0.070*	0.077***	-0.001	0.085**	-0.107**	0.044
	(-1.65)	(3.16)	(-0.03)	(2.28)	(-2.26)	(1.15)
Majority foreign-owned	-0.030	0.011	0.030	-0.072*	0.071**	0.015
	(-1.13)	(0.48)	(0.95)	(-1.82)	(2.50)	(0.41)
Exporter only	0.027*	0.058***	-0.009	0.078***	-0.006	0.067***
	(1.66)	(2.79)	(-0.44)	(3.01)	(-0.30)	(2.85)
Importer only	-0.011	0.005	0.034	0.112**	-0.046	0.105**
	(-0.53)	(0.22)	(0.84)	(2.03)	(-1.17)	(2.48)
Exporter & importer	-0.005	0.070***	-0.002	0.224***	-0.012	0.173***
	(-0.27)	(3.52)	(-0.06)	(5.78)	(-0.45)	(5.77)
Female Top Manager	0.012	-0.024	0.014	-0.002	0.014	-0.034
	(0.99)	(-1.17)	(0.65)	(-0.07)	(0.75)	(-1.33)
Subsidy	0.001	0.008	-0.004	0.061**	-0.034*	0.072***
	(0.03)	(0.37)	(-0.17)	(2.15)	(-1.70)	(3.43)
Share with university degree	0.000	0.001*	0.001**	0.001	-0.001	0.001
	(-0.13)	(1.77)	(2.25)	(1.12)	(-1.16)	(1.27)
Log sales per employee	-0.011		-0.021***		-0.010*	
	(-1.39)		(-3.31)		(-1.75)	
Real GDP growth rate	-0.001	-0.017***	-0.007***	-0.008**	0.001	-0.011***
	(-0.33)	(-4.74)	(-2.66)	(-2.00)	(0.36)	(-2.81)
Bank outreach	0.000		0.001		0.000	
	(0.71)		(1.51)		(-0.44)	
Non-performing loans	-0.001		-0.001		0.002	
	(-0.79)		(-1.50)		(1.42)	
Domestic credit	0.001*		0.000		0.002***	
	(1.65)		(-0.54)		(4.88)	
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.195	-1.548***	0.002	-0.876***	-1.109**	-1.589***
	(-1.47)	(-5.27)	(0.01)	(-4.24)	(-1.98)	(-5.12)
No of observations	1,806	1,806	2,032	2,032	1,468	1,468
Log likelihood	-743.1	-743.1	-2034	-2034	-941.8	-941.8

Note: the table reports marginal effects; z-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1;

Additionally, there is evidence that subsidies matter for an establishment's probability to innovate. Except for the financial normalcy phase, establishments that received any subsidies from the national, regional or local government or the European Union were more likely to pursue innovative activities (by between 6 and 7 percentage points). This suggests that in the run-up to the crisis but more so during the crisis – when firms' internal funds quickly dwindled – government support programmes proved successful in helping firms finance and pursue their innovative activities.

Surprisingly however, we fail to find much strong indication that human capital plays a decisive role for an establishment's probability to innovate: only during the financial normalcy phase are establishments with a higher share of employees with a university degree also more likely to pursue innovative activities. This finding is counter conventional wisdom which puts much emphasis on the importance of human capital for any successful innovative endeavour (see, e.g., Janz et al., 2003 or Silva et al., 2008).

Furthermore, our results also demonstrate that the gender of the top manager is irrelevant, both for a successful bank credit application as well as for being an innovator.

In addition, we also find no support of the assertion that establishments in faster growing economies have richer internal resources at hand and therefore more strongly pursue innovative activities. Quite the contrary, our results consistently show that the opposite is true: establishments in faster growing CESEE and FSU economies are actually less likely to pursue innovative activities.

4.2.2. M&E investors

Furthermore, Table 3 shows results for M&E investors and identifies the particular set of determinants that render an establishment more likely to invest in machinery and equipment, explicitly accounting for the endogenous nature of credit constraints. Columns (1), (3) and (5) again identify determinants of a rejection of a bank credit application while columns (2), (4) and (6) identify firm and country characteristics that render an establishment more likely to be an M&E investor.

Generally, there is again evidence that credit constraints exert a negative effect on an establishment's investment decision, which is in line with findings by Hasan (2013) who shows that the availability of credits renders firms significantly more likely to invest in plants, machinery and equipment. In particular, the results consistently highlight that, irrespective of particular economic phase considered, credit-constrained establishments are less likely to invest in machinery and equipment (M&E). This is in contrast to findings for the decision to invest in R&D where less robust findings emerged. Our results suggest that in the group of CESEE and FSU countries, the 'buy' innovation strategy – which is also the most dominant innovation strategies of establishments in the region (see Figure 1) – is more sensitive to prevailing credit constraints than the 'make' innovation strategy. Hence, prevailing credit constraints in the region severely slow down any technology adoption processes that prove to be vital in the context of economic development and catching-up. The effects of such funding obstacles, however, differ across economic periods and were strongest during the financial normalcy period, when credit-constrained establishments were almost 77 percentage points less likely to invest in machinery and equipment than financially unconstrained ones. By contrast, both, during the bubble phase and the crisis phase, credit-constrained establishments were only around 40 and 33 percentage points less likely to invest in M&E, respectively.

In line with results for R&D innovators, results for M&E investors also emphasise the advantageous nature of larger establishment size. Size-related effects are, however, slightly less consistent across economic periods. More specifically, during the financial normalcy phase, only large firms are more likely to invest in M&E (while no significant differences are present between small and medium-sized establishments). However, during both the bubble phase and the crisis phase, larger establishments are generally more likely to invest in M&E. The effect, however, appears to be stronger during the crisis phase, where large firms are almost 13 percentage points more likely to be M&E investors than small firms as opposed to only around 10 percentage points during the bubble phase. This finding suggests that during the crisis phase when global demand and exports collapsed and credits froze as a result of the global credit crunch, smaller establishments in CESEE and FSU countries were less inclined and also financially less able to invest in M&E to adopt new technologies, particularly since smaller firms were also significantly more likely to face credit constraints: our results confirm that during the crisis phase small establishments were around 5 percentage points more likely to face credit constraints than medium-sized firms and even 11 percentage points more likely to face credit constraints than large firms.

Furthermore, in contrast to findings for R&D innovators, young age is of strong relevance for an establishment's decision to invest in M&E and is found to matter during all economic phases considered but the pre-crisis bubble phase. In particular, during the phases of financial normalcy and crisis, young establishments are 5 and 14 percentage points more likely to invest in M&E than older establishments. This may indicate that young firms in CESEE and FSU countries either more strongly rely on the M&E-based 'buy' innovation strategy or that younger (and probably also smaller) firms are generally less reliant on R&D but more strongly pursue non-R&D-based, informal strategies to pursue innovative activities. Interestingly, our results for the crisis phase also show that this is true even though young establishments were also significantly more likely to face credit constraints (by almost 5 percentage points).

Similar to findings for R&D investments, an establishment's ownership status matters little only for its decision to invest in machinery and equipment and only in particular economic phases. Particularly, during the crisis phase only, establishments that were part of a larger firm were more likely to invest in M&E to adopt embodied technology (by around 11 percentage points), which was further facilitated by significantly lower credit constraints they faced during the crisis phase (by around 9 percentage points), lending empirical support to the internal-market hypothesis which posits that the existence of internal capital markets makes access to financing easier for firms that are part of a larger firm. Moreover, and in contrast to findings for R&D investments, majority foreign-owned establishments were more likely to invest in M&E (by between 7 and 9 percentage points) even though their bank loan applications were also more likely to be rejected (by around 7 percentage points). But this holds for the bubble phase only. The significantly higher propensity of majority foreign-owned establishments to face binding credit constraints suggests that while internal capital markets were no asset in the credit application process, they served as vital funding sources for M&E investments.

Again, there is strong evidence of the pivotal role of an establishment's trading status for its probability to invest. In particular, internationally trading firms were more likely to pursue 'buy' innovation strategies and to invest in technology embodied in machinery and equipment, particularly during the bubble phase and the crisis phase. Results again suggest a specific ranking, with establishments that both export and import being consistently most likely to invest in machinery and equipment (by between 16 and 17

percentage points), followed by establishments that export only (by between 5 and 9 percentage points). Less consistent results emerge for establishments that import only, however. Findings also highlight that during the financial normalcy phase exporters only had a much harder time accessing external funding sources than purely domestically oriented establishments.

Table 3 / Determinants of the probability to invest in machinery and equipment, by economic phase

	Financial normalcy		*Bubble phase*		*Crisis phase*	
	Rejected (yes=1)	M&E investor (yes=1)	Rejected (yes=1)	M&E investor (yes=1)	Rejected (yes=1)	M&E investor (yes=1)
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Credit-constrained		-0765***		-0.391***		-0.333*
		(-44.88)		(-7.96)		(-1.87)
Medium-sized	0.007	0.022	-0.023	0.067***	-0.047***	0.095***
	(0.73)	(0.96)	(-1.22)	(3.47)	(-2.97)	(3.13)
Large	0.007	0.082**	-0.032	0.094***	-0.108***	0.125***
	(0.61)	(2.55)	(-1.51)	(4.21)	(-4.07)	(2.96)
Young	0.000	0.051**	0.028	0.001	0.046**	0.135***
	(0.02)	(2.26)	(1.20)	(0.05)	(2.36)	(3.47)
Part of a larger firm	-0.074**	0.050	-0.001	0.040	-0.089**	0.108*
	(-2.00)	(1.03)	(-0.03)	(1.20)	(-1.99)	(1.84)
Majority foreign-owned	-0.018	0.041	0.043	0.066*	0.070**	0.098*
	(-1.33)	(1.21)	(1.45)	(1.83)	(2.46)	(1.74)
Exporter only	0.027***	0.063**	0.002	0.052**	-0.007	0.091***
	(2.56)	(2.09)	(0.11)	(2.44)	(-0.33)	(2.77)
Importer only	-0.003	0.017	0.042	0.108**	-0.037	0.074
	(-0.25)	(0.57)	(1.06)	(2.46)	(-0.96)	(1.20)
Exporter & importer	0.017	0.046	0.017	0.170***	0.000	0.156***
	(1.38)	(1.45)	(0.60)	(5.03)	(-0.01)	(3.22)
Female Top Manager	-0.002	-0.009	0.018	-0.012	0.010	-0.038
	(-0.27)	(-0.48)	(0.88)	(-0.57)	(0.57)	(-1.19)
Subsidy	0.011	0.005	0.004	0.069***	-0.032	0.129***
	(0.82)	(0.14)	(0.16)	(2.61)	(-1.61)	(3.91)
Share with university degree	0.000	0.000	0.001	0.000	0.000	0.000
	(-0.73)	(-0.81)	(1.63)	(-1.15)	(-1.09)	(-0.46)
Log sales per employee	-0.002		-0.032***		-0.016***	
	(-0.44)		(-5.23)		(-2.58)	
Real GDP growth rate	-0.001	-0.005	-0.007**	0.000	-0.001	-0.011**
	(-0.36)	(-1.30)	(-2.55)	(-0.17)	(-0.30)	(-2.07)
Bank outreach	0.000		0.001		-0.001	
	(0.21)		(1.30)		(-0.89)	
Non-performing loans	-0.001***		-0.001*		0.003*	
	(-2.73)		(-1.66)		(1.94)	
Domestic credit	0.000		0.000		0.001***	
	(0.44)		(-1.27)		(3.97)	
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.708***	0.553***	0.515	0.663***	-0.456	0.246
	(-3.200)	(4.10)	(1.36)	(3.37)	(-0.719)	(1.07)
No of observations	2,243	2,243	2,037	2,037	1,473	1,473
Log likelihood	-1672	-1672	-1782	-1782	-1285	-1285

Note: the table reports marginal effects; z-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1;

Similar to findings for R&D investments, subsidies matter for an establishment's decision to invest in machinery and equipment. Except for the financial normalcy phase, establishments that received subsidies from the national, regional or local government or the European Union were between 7 and 13 percentage points more likely to invest in machinery and equipment. Hence, government support programmes successfully encouraged and helped establishments to invest in machinery and equipment, thereby providing easier access to more advanced technologies embodied in machinery and equipment, which given the dominance of technology adoption among firms located in CESEE and FSU countries, is vital for the region's growth and catching-up endeavours.

In line with above findings for R&D investments but in contrast to findings by Hasan (2013) which show that establishments in Latin America are more likely to invest in plant, machinery and equipment if endowed with more skilled labour, human capital is of no relevance for a firm's decision to invest in machinery and equipment, irrespective of economic phase analysed. This is surprising since human capital is considered a vital factor in successful technology adoption processes.

Furthermore, our results again demonstrate that the gender of the top manager is irrelevant, both for a successful bank credit application as well as for being an innovator.

Finally, M&E investment decisions also depend on the state of the economy. In particular, during the crisis phase, establishments showed a lower willingness to invest in M&E when located in faster growing economies in the region.

5. Summary and conclusions

Innovations are pivotal to economic outcomes. However, innovative activities tend to be costly and highly uncertain which frequently induces entrepreneurs to resort to capital markets to raise the much needed funds. Here, however, as a result of information asymmetries between the debtor and potential outside investors, entrepreneurs often face sizeable and insurmountable financing constraints which discourage them to either start a new or continue an ongoing innovation project. This in turn not only undermines their own future innovation potentials and stymies their growth prospects but also critically impairs growth and development potentials of whole economies which makes catching-up an unnecessarily long and hard process. Hence, dismantling prevailing barriers to funding has become a major policy concern in many economically and technologically lagging economies.

Against this backdrop, the analysis sheds light on the role of binding credit constraints for an entrepreneur's decision to invest in innovation projects, differentiating between two innovation strategies, namely the R&D-based make strategy, on the one hand, and the M&E-based buy strategy, on the other. It uses data from the Business Environment and Enterprise Performance Survey (BEEPS) for a large set of transition economies and looks at three different economic phases which shaped the region in the last one and a half decades: (1) the phase of *'financial normalcy'* between 2000 and 2004, (2) the '*bubble'* phase between 2004 and 2008, and (3) the '*crisis'* phase following the global financial crisis of 2008.

Results underscore the detrimental effects of credit constraints but point to differences across innovation strategies and economic phases considered. In particular, irrespective of economic phase analysed, credit-constrained establishments are consistently less likely to pursue the buy strategy and invest in M&E, which, given the strong reliance of establishments in CESEE and FSU countries on the M&E innovation strategy, is of particular concern for economies seeking quick technology-induced development and catching-up with technologically more advanced economies, calling for policy intervention to guarantee less restrictive or even barrier-free access to bank finance. By contrast, less consistent results emerge for the R&D-based innovation strategy: credit-constrained establishments are less likely to pursue the make strategy and invest in R&D, but this only holds for the financial normalcy phase. Hence, innovators in CESEE and FSU countries appear to consider credit constraints less of a limiting factor for their innovative activities, at least after the financial normalcy phase.

Furthermore, the analysis identifies particular firm characteristics which affect an entrepreneur's decision to pursue either the R&D-based make or the M&E-based buy innovation strategy and points to similarities but also differences across strategies and economic phases. For instance, it demonstrates that larger establishments are generally more likely to invest in R&D or M&E in pursuance of either the make or the buy innovation strategy. This size effect is, however, more robust across economic phases for the M&E-based buy strategy than the R&D-based make strategy. Similar consistent result emerge for internationally trading establishments, suggesting a specific ranking, with establishments that both export and import being most likely to invest in R&D or M&E, followed by establishments that import only while exporters only were the bottom of the league. Furthermore, subsidies play a non-negligible role for an establishment's decision to pursue either the make or the buy innovation strategy and proved

successful in helping firms pursue and realise their innovation strategies, particularly during the bubble and crisis phases.

Concerning differences across strategies and economic phases, our results suggest that young establishments in the region appear to more strongly rely on the M&E-based buy strategy. Similarly, ownership status matters for different innovation strategies, with differences across economic phases, however: during the bubble phase, majority foreign-owned establishments were more likely to pursue the buy strategy but less likely to pursue the make strategy. Establishments that are part of a larger firm were more likely to invest in R&D during the financial normalcy and bubble phases but more likely to invest in M&E during the crisis phase. Finally, no strong role is found for human capital for an establishment's decision to invest in either R&D or M&E.

Our results generally point to important areas of policy intervention. On the one hand, the sizeable and harmful effect of credit constraints on R&D activities, but more importantly, on M&E investment activities calls for the introduction of policies that help reduce or altogether dismantle existing credit constraints to foster innovative activities of firms and speed up catching-up and convergence of CESEE and FSU countries. On the other hand, policies (such as specific guarantee-schemes) need to be implemented that support young and small firms that have a particularly hard time accessing bank loans and credits.

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7. Annex

Table A.1 / Overview of the number of establishments, by country and economic phase

REP	Country	Financial normalcy	Bubble phase	Crisis phase	Total
AL	Albania	204	175	360	739
AM	Armenia	351	374	360	1,085
BA	Bosnia and Herzegovina	200	361	360	921
BG	Bulgaria	300	288	293	881
CZ	Czech Republic	343	250	254	847
EE	Estonia	219	273	273	765
GE	Georgia	200	373	360	933
HR	Croatia	236	159	360	755
HU	Hungary	610	291	310	1,211
LT	Lithuania	205	276	270	751
LV	Latvia	205	271	336	812
MD	Moldova	350	363	360	1,073
ME	Montenegro	0	116	150	266
MK	FYR Macedonia	200	366	360	926
PL	Poland	975	455	542	1,972
RO	Romania	600	541	540	1,681
RS	Serbia	0	388	360	748
SI	Slovenia	223	276	270	769
SK	Slovak Republic	220	275	268	763
UA	Ukraine	594	851	1,002	2,447
XK	Kosovo	0	270	202	472
Total		6,235	6,992	7,590	20,817

Table A.2 / Summary statistics, by economic phase

	Financial normalcy	***Bubble phase***	***Crisis phase***
	Mean (*St.Dev.)*	Mean (*St.Dev.*)	Mean (*St.Dev.*)
	[Min, Max]	[Min, Max]	[Min, Max]
R&D innovator	0.16 (*0.36*)	0.27 (*0.44*)	0.11 (*0.31*)
	[0, 1]	[0, 1]	[0, 1]
M&E investor	0.75 (*0.43*)	0.63 (*0.48*)	0.44 (*0.50*)
	[0, 1]	[0, 1]	[0, 1]
Credit-constrained	0.04 (*0.21*)	0.14 (*0.35*)	0.09 (*0.28*)
	[0, 1]	[0, 1]	[0, 1]
Medium-sized	0.27 (*0.44*)	0.33 (*0.47*)	0.29 (*0.45*)
	[0, 1]	[0, 1]	[0, 1]
Large	0.17 (*0.38*)	0.25 (*0.43*)	0.12 (*0.33*)
	[0, 1]	[0, 1]	[0, 1]
Young	0.14 (*0.35*)	0.15 (*0.36*)	0.13 (*0.34*)
	[0, 1]	[0, 1]	[0, 1]
Part of a larger firm	0.06 (*0.25*)	0.01 (*0.30*)	0.07 (*0.26*)
	[0, 1]	[0, 1]	[0, 1]
Majority foreign-owned	0.09 (*0.29*)	0.09 (*0.28*)	0.06 (*0.24*)
	[0, 1]	[0, 1]	[0, 1]
Exporter only	0.10 (*0.30*)	0.17 (*0.37*)	0.14 (*0.35*)
	[0, 1]	[0, 1]	[0, 1]
Importer only	0.13 (*0.33*)	0.03 (*0.18*)	0.04 (*0.19*)
	[0, 1]	[0, 1]	[0, 1]
Exporter & importer	0.15 (*0.36*)	0.08 (*0.27*)	0.07 (*0.25*)
	[0, 1]	[0, 1]	[0, 1]
Female TM	0.21 (*0.41*)	0.20 (*0.40*)	0.21 (*0.41*)
	[0, 1]	[0, 1]	[0, 1]
Subsidy	0.09 (*0.29*)	0.10 (*0.30*)	0.12 (*0.32*)
	[0, 1]	[0, 1]	[0, 1]
Share with university degree	25.79 (*28.78*)	21.09 (*25.56*)	26.16 (*28.62*)
	[0, 100]	[0, 100]	[0, 100]
Log sales/employee	9.96 (*0.99*)	10.13 (*1.46*)	10.14 (*1.55*)
	[1.51, 13.11]	[1.1, 17.11]	[2.65, 24.38]
Real GDP growth rat	6.89 (*2.42*)	7.40 (*2.92*)	3.75 (*2.26*)
	[4.13, 12.10]	[0.11, 13.75]	[-0.23, 9.56]
Bank outreach	22.12 (*17.53*)	25.16 (*17.29*)	24.85 (*13.25*)
	[3.72, 84.26]	[3.85, 86.94]	[1.60, 59.84]
NPLs	10.11 (*9.00*)	11.44 (*19.10*)	11.06 (*4.96*)
	[0.40, 28.3]	[0.20, 59.8]	[3.00, 23.3]
Domestic credit	35.28 (*14.47*)	42.56 (*21.01*)	66.71 (*22.69*)
	[5.56, 57.49]	[7.03, 89.70]	[17.10, 98.45]
	N=6236	N=6992	N=7590

Table A.3 / Correlation matrix – Financial normalcy

	Constrained	Medium	Large	Young	Part	MajForeign	Exponly	Imponly	Expimp	Female	Subsidy	UnivDegree	LnSalesPE	GrGDP	Outreach	NPLs	DomCredit
Constrained	1.000																
Medium	-0.012	1.000															
Large	-0.004	-0.169	1.000														
Young	0.015	-0.109	-0.065	1.000													
Part	-0.036	0.086	0.101	-0.016	1.000												
MajForeign	-0.026	0.067	0.166	0.028	0.088	1.000											
Exponly	0.047	0.076	0.086	-0.050	0.066	0.087	1.000										
Imponly	-0.023	0.021	0.015	0.009	0.003	0.178	-0.107	1.000									
Expimp	0.000	0.109	0.237	-0.027	0.092	0.256	-0.107	-0.110	1.000								
Female	0.027	-0.140	-0.153	0.085	-0.074	-0.127	-0.082	-0.069	-0.068	1.000							
Subsidy	0.000	0.090	0.227	-0.033	0.038	-0.017	0.033	0.010	0.070	-0.095	1.000						
UnivDegree	-0.047	0.016	-0.046	0.017	0.028	0.161	0.040	0.108	0.063	-0.040	0.054	1.000					
LnSalesPE	0.009	-0.037	0.012	-0.102	0.075	0.115	0.060	0.110	0.157	-0.062	0.028	-0.063	1.000				
GrGDP	-0.043	0.045	-0.002	0.095	-0.024	-0.012	-0.033	-0.045	-0.108	0.005	-0.058	0.214	-0.512	1.000			
Outreach	0.025	-0.038	0.012	-0.096	-0.025	0.011	0.017	-0.015	0.010	-0.006	0.041	-0.081	0.182	-0.347	1.000		
NPLs	-0.030	0.004	-0.023	0.048	-0.036	-0.065	0.016	-0.104	-0.101	0.049	-0.016	0.020	-0.099	0.354	-0.240	1.000	
DomCredit	0.045	-0.011	-0.019	-0.064	-0.002	0.009	0.056	0.008	0.067	0.049	0.074	-0.160	0.510	-0.516	0.052	-0.165	1.000

Table A.4 / Correlation matrix – Bubble phase

	Constrained	Medium	Large	Young	Part	MajForeign	Exponly	Imponly	Expimp	Female	Subsidy	UnivDegree	LnSalesPE	GrGDP	Outreach	NPLs	DomCredit
Constrained	1.000																
Medium	-0.023	1.000															
Large	-0.016	-0.513	1.000														
Young	0.046	0.001	-0.143	1.000													
Part	-0.007	-0.002	0.122	0.021	1.000												
MajForeign	0.015	-0.054	0.191	0.027	0.180	1.000											
Exponly	-0.024	0.019	0.102	-0.038	-0.008	0.076	1.000										
Imponly	0.022	0.042	0.006	0.035	-0.010	-0.025	-0.104	1.000									
Expimp	-0.004	-0.032	0.217	-0.086	0.047	0.112	-0.197	-0.075	1.000								
Female	0.023	-0.039	-0.048	-0.030	-0.018	-0.001	-0.013	-0.032	-0.017	1.000							
Subsidy	-0.009	0.003	0.153	-0.069	0.063	0.001	0.086	0.034	0.181	-0.009	1.000						
UnivDegree	0.026	-0.043	-0.054	0.046	0.041	0.042	-0.022	-0.045	-0.043	-0.002	-0.102	1.000					
LnSalesPE	-0.081	0.018	-0.012	-0.063	0.046	0.081	0.105	-0.053	0.057	-0.038	0.079	-0.046	1.000				
GrGDP	-0.030	-0.005	-0.037	0.141	0.005	-0.038	-0.062	0.051	-0.037	-0.018	-0.131	0.302	-0.124	1.000			
Outreach	0.013	-0.006	0.016	-0.060	0.031	0.003	0.089	-0.021	0.089	-0.002	0.067	-0.231	0.251	-0.064	1.000		
NPLs	-0.020	-0.020	0.041	-0.030	0.015	0.020	-0.038	0.001	-0.024	0.006	-0.107	0.145	-0.232	0.011	-0.445	1.000	
DomCredit	-0.031	-0.004	0.067	-0.131	0.084	0.030	0.075	-0.008	0.085	0.057	0.233	-0.226	0.328	-0.229	0.174	-0.104	1.000

Table A.5 / Correlation matrix – Crisis phase

	Constrained	Medium	Large	Young	Part	MajForeign	Exponly	Imponly	Expimp	Female	Subsidy	UnivDegree	LnSalesPE	GrGDP	Outreach	NPLs	DomCredit
Constrained	1.000																
Medium	-0.052	1.000															
Large	-0.092	-0.335	1.000														
Young	0.099	-0.039	-0.067	1.000													
Part	-0.050	0.004	0.125	-0.025	1.000												
MajForeign	0.029	0.003	0.184	0.005	0.147	1.000											
Exponly	-0.006	0.060	0.013	-0.056	0.003	0.117	1.000										
Imponly	-0.019	0.024	-0.039	-0.014	0.036	-0.013	-0.105	1.000									
Expimp	-0.022	-0.004	0.249	-0.028	0.051	0.112	-0.170	-0.078	1.000								
Female	0.010	-0.046	-0.039	-0.028	-0.008	-0.035	-0.046	-0.019	-0.060	1.000							
Subsidy	-0.050	0.054	0.135	-0.070	0.046	0.059	0.103	0.003	0.215	-0.009	1.000						
UnivDegree	-0.032	-0.065	-0.071	0.013	0.054	0.012	-0.031	0.015	-0.080	0.001	-0.101	1.000					
LnSalesPE	-0.062	0.058	-0.055	-0.103	-0.030	0.012	0.073	-0.021	0.051	-0.053	0.140	-0.031	1.000				
GrGDP	-0.003	0.005	-0.047	0.086	0.042	-0.058	-0.083	0.010	-0.098	0.033	-0.136	0.274	-0.245	1.000			
Outreach	-0.039	0.001	0.057	-0.083	-0.091	0.063	0.084	-0.049	0.096	0.012	0.101	-0.221	0.263	-0.623	1.000		
NPLs	0.083	0.011	0.033	0.007	0.048	0.014	0.045	-0.007	0.009	0.043	-0.009	-0.144	-0.058	-0.180	0.157	1.000	
DomCredit	0.119	-0.016	0.046	-0.067	0.067	0.049	0.111	-0.017	0.130	0.021	0.217	-0.180	0.190	-0.229	0.098	0.254	1.000

Table A.6 / List of variables

Variable	Definition	Source
R&D innovator	Dummy=1 if establishment reports positive R&D expenditures (in-house or outsourced), zero otherwise	BEEPS
M&E investor	Dummy=1 if establishment purchased fixed assets like machinery, vehicles or equipment, zero otherwise	BEEPS
Credit-constrained	Dummy=1 if establishment applied for bank loan but was rejected, zero otherwise	BEEPS
Medium-sized	Dummy=1 if establishment is medium-sized with between 20 to 99 employees, zero otherwise	BEEPS
Large	Dummy=1 if establishment is large with more than 99 employees, zero otherwise	BEEPS
Young	Dummy=1 if establishment is less than 6 years of age, zero otherwise	BEEPS
Part of a larger firm	Dummy=1 if establishment is part of a larger firm, zero otherwise	BEEPS
Majority foreign-owned	Dummy=1 if more than 50% is owned by foreign individuals/organisations, zero otherwise	BEEPS
Exporter only	Dummy=1 if establishment is exporter only, zero otherwise	BEEPS
Importer only	Dummy=1 if establishment is direct importer of intermediates only, zero otherwise	BEEPS
Exporter and importer	Dummy=1 if establishment reports both positive export sales and expenditures from direct imports, zero otherwise	BEEPS
Female Top Manager	Dummy=1 if the establishment's top manager is female, zero otherwise	BEEPS
Subsidy	Dummy=1 if establishment received any subsidies from the national, regional or local government or the EU, zero otherwise	BEEPS
Share with university degree	The percentage of an establishment's labour force with a university degree	BEEPS
Log sales per employee	Log of sales per employee (in EURO)	BEEPS
Real GDP growth rate	Annual real GDP growth rate	WDI
Bank outreach	Number of branches of commercial banks per 100,000 adults	WDI
Non-performing loans	Ratio of bank non-performing loans to total gross loans	WDI
Domestic credit	Domestic credit provided by the banking sector (in % of GDP)	WDI

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