

International Integration of Firms and Demand for Skills

Draft

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Abstract

We study empirically how participation in international activities affects firms' demand for skills and the ways in which firms accommodate this demand in 26 transition economies using Business Environment and Enterprise Performance Survey 2002-2009. We contribute to the literature by studying two related ways in which firms respond to changes in the demand for skills (changing the share of skilled labour and training their employees), by using several measures of international integration (foreign ownership, exporting, importing and supplying MNEs) and by using fixed effects and difference in difference estimation methods. Our results suggest that firms engaged in international activities have a better educated labour force and are more likely to train their production and nonproduction employees than domestic firms. However, this happens because firms with better skilled workforces and with formal training programmes select into participating in international activities, and not because these firms upgrade the skills of their workforces after starting to participate in international activities.

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1 Introduction

Over the last decades, many countries have experienced increases in wage inequality between skilled workers and unskilled workers, despite increases in the supply of skilled labour, which implies an increase in the relative demand for skilled labour. The literature suggests that globalisation has played an important role in increasing the relative demand for skilled labour.

The main mechanisms through which globalisation can affect the relative demand for skills in developing countries are: transfer of skilled biased technology change through trade and (Acemoglu, 1998, Keller, 2004), specialisation according to comparative advantage in goods/activities intensive in unskilled labour, outsourcing of activities or goods which are relatively unskilled labour intensive from perspective of a developed country but relatively skilled labour intensive from the perspective of a developing country (Feenstra and Hanson, 1996; Zhu and Trefler, 2005) and adoption of skill intensive technology in order to improve competitiveness in international markets (Yeaple, 2005; Bustos, 2007; Verhoogen, 2008). These theoretical models, which will be reviewed more in detail in section 2.1, predict two different effects. Adoption of skilled biased technology change through trade and FDI, outsourcing of more skilled intensive goods from developed countries and from adoption of more skilled intensive technology in order to become more competitive in international markets have a positive effect on the relative demand for skilled labour. Specialisation in goods intensive in unskilled labour according Heckscher-Ohlin (HO) model has a negative effect on the relative demand for skilled labour. The overall effect is ambiguous. It depends on which of the two effects prevails. The empirical evidence on the effect of globalisation on the demand for skilled labour is also mixed.

Another aspect that is important to consider is how the firms respond to changes in the demand for skilled labour. Firms can accommodate this change either by hiring employees with the needed skills from outside the firm or by upgrading the skills of their employees by training them. Most of the theoretical studies assume that firms meet these changes by hiring employees with the needed skills from outside the firm which leads to a rising share of skilled labour in employment. However, firms can also accommodate changes in the demand for skills by training their employees. Training employees may be even preferable to hiring skilled employees if the firm needs skills which employees in the local labour market do not have. This is likely to be the case of internationally integrated firms in developing or transition countries if they use technology created in developed countries. This technology was created to be complementary to labour skills in developed countries, which might be different from the labour skills in developing and transition countries. There are few econometric studies on the effect of international integration on provision of training, but most of them find that international integration is associated with provision of personnel training.

In this paper, we study empirically how participation in international activities affects firms' demand for skilled labour and the ways in which firms respond to changes in demand for skilled labour in 26 transition economies in Europe and Central Asia (ECA) using the BEEPS 2002-2009 dataset. This research contributes to the literature in several ways.

First, we study two related ways in which firms respond to changes in the demand for skills: changing the share of labour with the required skills in total employment and training their employees. While there are many empirical studies that examine the impact of globalisation on the share of skilled labour (Harrison and Hanson, 1999; Pavnik, 2003; Commander and

Kollo, 2008; Fajnzylber and Fernandes, 2009; Almeida, 2010), there is little evidence on the impact of globalisation on provision of training (Tan and Batra, 1996, Tan et. al., 2007). We also use several measures of skilled labour and provision of training: share of employees with tertiary education, share of nonproduction employees, share of skilled production employees, provision of formal training, provision of formal training to nonproduction employees and provision of training to production employees.

Second, we use several measures of international integration: foreign ownership, exporting, importing and supplying MNEs. The effect of foreign ownership, exporting and importing on demand for skilled labour upgrading has been extensively studied before, for instance by Harrison and Hanson (1999), Pavnik (2003), Commander and Kollo (2008), Almeida (2010) and Fajnzylber and Fernandes (2009). Many of the mechanisms through which FDI and international trade affect demand for skilled labour can also apply to supplying MNEs, but the effect of supplying MNEs on skill upgrading has not been examined in the previous studies.

Thirdly, we use several empirical methods to study the effect of globalisation on firms' demand for skills. First, using the cross sectional dimension of our data, we study whether firms that participate in international activities employ more skilled workforce and whether they are more likely to provide formal training to their employees. We do this by comparing firms that participate in international economic activities to purely domestic firms that operate in the same country and industry after controlling for other firm characteristics. Then, using the panel dimension of our survey, we will test whether the relationship between skill upgrading and international integration is robust to controlling for unobserved firm characteristics. Most of the existing studies with the exception of Pavcnik (2003) do not

control for firm unobserved characteristics, mainly due to data limitations, but controlling for these characteristics is important because they may affect both the participation in international activities and the demand for skilled labour and thus their omission might lead to biased estimates. Finally, we will also explore information on firms starting, continuing and stopping to participate in international activities during the periods studied to examine whether firms upgrade the skills of their workforce after starting to participate in international activities or whether firms with better skilled workforce select into participation in international activities.

The transition economies in Central and Eastern Europe and former Soviet Union provide an interesting setting for studying the effects of globalisation on demand for skilled labour. These countries lag behind developed countries in terms of technology, but unlike many developing countries, they have a highly educated labour force (World Bank 1996, 2001; World Bank Development Indicators, 2010). This suggests that skill biased technology change may play an important role. The high share exports of goods intensive in unskilled labour in the exports of many transition economies (World Bank, 2005) suggests that specialisation in goods intensive in unskilled labour according to HO model might be an important determinant of demand of skilled labour. Finally, the proximity of these countries to EU market (at least those located in Europe) and their access to EU market through a variety of trade agreements means that outsourcing of more skilled intensive goods from developed countries and adoption of more skilled intensive technology in order to become more competitive in international export markets could also play important roles.

From a policy perspective, these questions are very relevant for most of transition countries in ECA in view of the increasing wage inequality and of the problem of skill shortages in

these countries. Since the beginning of the transition process, the returns to education, especially university education, increased in all the transition economies in the region (Svejnar, 1999), despite increase in the supply of skilled labour during this period (World Development Indicators, 2010). Recently, the problem of skill shortages in transition countries has been highlighted by several studies (World Bank, 1996, 2001; Commander and Kollo, 2008; Rutkowski, 2007; Tan et al. 2007). These studies argue that at least some of the skills acquired through education during the central planning and also during the transition before the education system was reformed do not correspond to the skills required by employers in a market economy. Simultaneously, the increasing exposure of these countries to international trade and FDI has increased considerably and it has been suggested that this exposure is an important factor influencing the demand for skills.

Our main results suggest that firms engaged in international activities have a better educated labour force and are more likely to train their production and nonproduction employees than domestic firms. However, this happens because firms with better skilled workforces and with formal training programmes select into participating in international activities, and not because these firms upgrade the skills of their workforces after starting to participate in international activities.

The paper is structured as follows. In section 2 we review the main theoretical and empirical studies related on to our study. Section 3 presents the data used in this study. Section 4 presents the empirical strategy. Section 5 presents the main estimation results and robustness checks. Section 6 concludes and discusses the main findings.

2 Literature Review

2.1 Theoretical literature

The theoretical literature proposes several mechanisms through which globalisation can affect the relative demand for skilled labour.

Skill biased technology change (SBTC) is regarded as the main explanation of the changes in relative demand for skilled labour in developed economies since 1970s. According to this explanation, technologies introduced during this period, like computers and automation technologies, are complementary to skilled labour and firms that adopted these technologies increased their relative demand of skilled labour. According to Acemoglu (1998), SBTC has taken place in developed countries since 1970s because the increase in the supply for skilled labour in developed countries lowered the relative cost of adopting skill intensive technology. A large number of studies, including Berman et al. (1994), Doms et al. (1997), Autor, Katz and Krueger (1998), Berman et al. (1998), Machin and Van Reenen (1998) provide empirical evidence that introduction of SBTC explains an important part of the increase in the relative demand for skilled labour in developed countries, on the basis of finding strong positive association between use of ICT and/or R&D investment or other technology measures and increases in the wage share of nonproduction employees.

SBTC is also regarded as an important explanation of increases in the demand for skilled labour in developing and transition countries. In these countries, which are assumed to be abundant in unskilled labour, SBTC takes place through the technology transfer from developed countries. International trade and FDI play important roles as channels through which skilled biased technology is transferred to developing and transition countries (Keller, 2004). This technology transferred from developed countries is likely to be skill biased

because it is created to be complementary to skilled labour, which is abundant in developed countries (Acemoglu, 1998). These firms which are globally engaged through trade or FDI use a more skill intensive technology than domestic firms and therefore they employ a more skilled workforce.

Another mechanism through which globalisation can affect the demand for skilled labour is specialisation according to comparative advantage. The HO trade model assumes that developed countries are abundant in skilled labour and developing countries are abundant in unskilled labour. In the HO model trade between developed and developing countries leads to specialisation in skill intensive goods in developed countries and specialisation in unskilled labour intensive goods in developing countries. The specialisation in unskilled labour intensive goods in developing countries results in a decrease in the relative demand for skilled labour in these countries. This implies that exporters in developing countries specialise in goods or stages of production which are intensive in unskilled labour in which they have a comparative advantage over producers in developed countries due to lower labour costs. Similarly, firms import intermediate inputs which are intensive in skilled labour, and concentrate on stages of production which are more intensive in unskilled labour. This mechanism focuses on trade, but FDI can play a similar role, especially vertical FDI, which aims to take advantage of lower wages in developing countries. If the activities intensive in skilled labour are undertaken by the parent MNEs and the foreign affiliates specialise in activities intensive in unskilled labour, then the demand for skilled labour in these countries will decrease. Similarly, MNEs might decide to purchase only basic inputs with little technological content from their local suppliers.

A third mechanism through which globalisation can lead to a rise in the relative demand for skilled labour is the outsourcing of activities by multinationals from developed countries to developing countries. Feenstra and Hanson (1997) propose a model in which firms in developed countries outsource to developing countries activities which are relatively unskilled labour intensive from the perspective of a developed country but relatively skilled labour intensive from the perspective of a developing country. As a result, outsourcing leads to increases in the relative demand for skilled labour in both developed and developing countries. In line with the predictions of this model, Feenstra and Hanson (1996) show that outsourcing, measured as share of imported intermediated inputs in the total purchase intermediate inputs, contributed substantially to increase in the wage bill share of nonproduction employees in US manufacturing between 1979 and 1990 and Feenstra and Hanson (1997) show that the increase in relative wages of skilled workers between 1975 and 1988 in Mexico was associated with inflows of foreign direct investment in the region and. Zhu and Trefler (2005) propose a similar model in which the rise in the demand of skilled labour in developed and developing countries is caused by the movement of the production of the least skill intensive goods in developed countries to the developing countries. In developing countries these goods are more skill intensive than the goods already produced there. This movement of the production of less skill intensive goods from developed to developing countries raises the demand for skilled labour in both developed and developing countries. These models imply that firms which are internationally integrated produce more skill intensive goods or perform more skill intensive stages of production than domestic firms.

Another important mechanism through which globalisation affects firm demand for skilled labour is by influencing the technology choices of firms. Yeaple (2005) and Bustos (2007)

propose models in which firms choose between two technologies. One technology is skilled labour intensive and has a high fixed cost, but allows the firms to achieve low marginal costs. The other technology is less skill-intensive, has a lower fixed cost, but involves higher marginal costs. In this model, increases in export sales increase the incentives to adopt the skill intensive technology, which leads to skill upgrading. Verhoogen (2008) proposes a similar model, but focuses on quality upgrading in developing countries. In this model, firms choose between two technologies: one that is skill intensive and produces high quality goods and one that is less skill intensive and produces lower quality goods. Quality is more important for export markets in developed countries than for domestic markets. Therefore, increases in exports to developed countries lead to increases in the incentives to adopt the skill intensive technology which produces high quality goods and, thus, to skill upgrading. These models imply that firms that are internationally integrated use a more skill intensive technology than domestic firms that allows them to achieve lower marginal costs or higher quality than domestic firms. Given that this technology is more skill intensive their workforce should be better skilled than the workforce of local firms. These models refer mainly to international trade but they can be relevant for FDI, especially vertical FDI and for suppliers of MNEs located in the same country because they face similar tougher requirements in terms of prices and quality from their customers.

The studies reviewed so far assume that firms meet these changes in demand by hiring employees with the needed skills from outside the firm which leads for a rising share of skilled labour in employment and wage bill. However, firms can also accommodate the increasing demand for skills by upgrading the skills of their employees by training them. All the mechanisms reviewed above may result in training of employees rather than hiring employees from outside the firm. Training employees may be even preferable to hiring

skilled employees if the firm needs skills which employees in the local labour market do not have. This is likely to be the case of internationally integrated firms in developing or transition countries if they adopt technology created to complement the labour skills available in developed countries, which might differ from the labour skills in developing and transition countries.

There are several studies on horizontal FDI spillovers which link technology transfer through FDI to training of local employees in MNEs' foreign affiliates (Blomstrom and Kokko, 1998; Fosfuri et al., 2001; Gorg, Strobl and Walsh, 2007). These studies argue that an important part of the technology transfer from parent MNEs to their foreign affiliates takes place through training the employees of these affiliates. This training is necessary to enable to employees of the foreign affiliate to use the technology of parent MNEs. Horizontal spillovers arise when employees trained in the foreign affiliates move to local firms. These models focus only on training to enable employees in foreign affiliates to use the technology developed by the parent MNEs. However, these arguments could easily apply to MNEs suppliers that adopt new technologies in order to adapt to the requirement of their customers or to importers that use inputs that embody new technologies.

Overall, the theoretical literature suggests that in developing countries the effect of globalisation on the demand for skilled labour is the result of two opposite effects: a positive effect due to skilled biased technology change facilitated by trade and FDI, outsourcing of goods which are more skill intensive than those already produced in developing countries and adoption of new technology in order to become more competitive in export markets, and a negative effect due to specialisation in goods intensive in unskilled labour. The overall effect

is ambiguous. Also it suggests that the changes in the demand for skilled labour can be met by either hiring skilled employees from outside the firm or by training existing employees.

2.2 Related Empirical Studies

In this section we discuss empirical studies most relevant for our investigation. This research is closely related to two strands of literature: studies on the relationship between international integration of firms and the share of skilled labour in total employment or wage bill and studies on the relationship between firms' participation in international activities and provision of training. We will focus in this review on the firm level studies in transition countries or developing countries which are most relevant to this study.

Most studies on this topic focus on two of the mechanism through which globalisation affects demand for skilled labour: specialisation in goods intensive in unskilled labour and skill biased technology change. The empirical approach used in these studies is to compare the use of skilled labour in firms that are involved in international activities and domestic firms, after controlling for other firm characteristics. Studies on provision of training use a similar approach. To do this they estimate variants of the following reduced form equation:

$$Skill_{it} = \alpha I_{it} + \beta T_{it} + \gamma X_{it} + \mu_i$$

In this equation, i represents the firm. $Skill$ is a measure of workforce skills. The most commonly used measure is the share of nonproduction in employment, but several studies also used share of employees with tertiary education (Commander and Kollo, 2008; Fajnzylber and Fernandes, 2009; Almeida, 2010), and measures of provision of training (Tan and Batra, 1996, Tan et. al., 2007).

I represents measures of international integration. T denotes measures of firm technology and X represents other firm characteristics that affect demand for skills. A positive relationship

between participation in international activities and the share of skilled labour is interpreted as evidence that the positive effect of skill biased technology transfer outweighs the negative effect of specialisation in goods intensive in unskilled labour. A negative or an insignificant relationship between participation in international activities and the share of skilled labour is interpreted as evidence that the positive effect of skill biased technology transfer is are offset by the negative effect of specialisation in goods intensive in unskilled labour.

One of the first firm level studies on this topic in a developing country is Harrison and Hanson (1999). They use a sample of manufacturing firms in Mexico which covers the period 1984-1990 to study how foreign ownership, exporting and importing material inputs affect the demand for nonproduction labour. Their measures of skilled labour are the shares of nonproduction employees in employment and in the wage bill. They find that foreign ownership, exporting and importing are associated with higher relative wages for nonproduction workers and, more relevant for our study, higher relative employment of nonproduction workers.

Pavcnik (2003) studies how the use of imported material inputs, foreign patents and foreign technical assistance affect nonproduction workers share of total wages and employment using a panel of Chilean manufacturing firms which covers the period 1979-1986. One the main contribution of this study compared with previous ones is that it examines whether the effect of globalisation on demand for skilled labour is robust to controlling for firm fixed effects. Pavcnik (2003) argues that it is possible that firms with certain unobserved characteristics are more likely to participate in international activities and that these firms also employ a higher share of skilled labour before and after the adoption of foreign technology. In this case the cross section correlation between participation in international activities and skilled labour

does not reflect a causal link between the two. She finds that imports of material inputs, foreign patents and foreign technical assistance are positively associated with the share of nonproduction workers in total wages and employment, but their effect becomes insignificant when she controls for firm unobserved characteristics.

Recently, several studies examined this question using data similar to the BEEPS surveys. These studies have the advantage of using measures of skilled labour based on workforce education which reflect better the workforce skills than the production/nonproduction employees distinction used in previous studies. In addition, they study the effect of globalisation on demand for skills in several countries and examine whether this effect differs across countries.

Commander and Kollo (2008) study the relationship between the international integration of firms, technology adoption and on demand of skilled labour changes in three transition economies (Hungary, Romania and Russia) at different stages in their transition process. They use data from an EBRD survey similar to BEEPS. Their measures of skilled labour are the shares of labour with different levels of education and different occupation categories in employment. Their measures of international integration are: starting a joint venture with foreign partners and exporting. They find that in Hungary and Romania measures of international integration and adoption of new technology have different effects. In these countries measures of international integration are associated with increases in the employment of workers with primary education, while measures of technology adoption are positively associated with the share of employees with secondary education and negatively associated with the share of employees with primary education and unskilled workers. For Russia, most of the results are insignificant, which the authors argue that is due to the lack of

enterprise restructuring during the period studied. Taken together, these results show that firms in these transition countries are affected by both skill biased technology change which is associated with an increase in demand for skill, but also that specialisation in goods intensive in unskilled labour is also an important factor and that these effects depend on the progress made with the transition process.

Fajnzylber and Fernandes (2009) study the effect of foreign ownership, importing and exporting on the demand of skilled labour in a cross section of manufacturing firms in Brazil and China. They use data from World Bank Enterprise Survey (WBES), which is a survey similar to BEEPS. Their measures of workforce skills are: share of nonproduction workers (managerial, professional and other nonproduction employees) in total employment and in the wage bill, share of management and professional workers in total employment and in the wage bill and the share of workers with some university education in total employment and in the wage bill. In Brazil, Fajnzylber and Fernandes (2009) find that international activities are associated with a higher share of employees with high education and nonproduction employees, which they interpret as evidence of diffusion of skill biased technology through these channels. For China, they find that importing and exporting are associated with lower demand for skilled labour and FDI has an insignificant effect on the demand for skilled labour. They argue that their negative results for China are due to specialisation in goods intensive in unskilled labour, which outweighs the effect of skill biased technology change. The authors also use instrumental variables methods to control for the possibility that participation in exporting, importing and FDI may be endogenous if firms with a better educated workforce are more likely to become exporters or importers or to be acquired by foreign MNEs. The results from the instrumental variable estimations confirm their initial results. Overall, their results show that in more advanced developing countries like Brazil the

positive skill biased technology change outweighs the negative effect of specialisation in unskilled labour, while in less advanced ones like China the opposite occurs.

Almeida (2010) studies the relationship between participation in international activities and demand for skilled labour in a cross section of manufacturing firms from 8 countries in East Asia at different stages of development. Their data also comes from WBES. Two measures of skilled labour are used in this study: the share of employees with more than secondary education and the share of nonproduction employees (managerial, professional and other nonproduction employees). Almeida (2010) finds that while foreign ownership is always associated with a higher demand for skilled labour, export intensity is associated with demand for skilled labour only in middle income countries except China. In low income economies and in China, export intensity is associated with lower demand for skilled labour. Almeida (2010) argues that the results for China and low income countries in East Asia are due to specialisation in goods intensive in unskilled labour. These results support the hypothesis that participation in international activities has a positive effect on demand for skilled labour in more advanced developing countries and a negative effect in the less advanced ones.

There are also several studies on the effect of participation in international activities on provision of formal training. Tan et al (2007) study the determinants of the probability of provision of training in a cross section of Russian firms using the Russia Competitiveness and Investment Climate Survey. They estimate a probit model in which the probability of a firm providing formal training to its employees depends on measures of international integration (exporting and foreign ownership) and technology measures and other control variables. They find that firms that export are more likely to train their employees, but they do not find

similar evidence for foreign ownership. They interpret these results as evidence of exporting firms adapting the skills of the employees to the change in technology and change in the quality of goods produced in order to meet the standards of foreign buyers. Tan and Batra (1996) also study the determinants of provision of training and international activities in Columbia, Indonesia, Malaysia, Mexico, Taiwan and China. They estimate a probit model in which the probability that a firm provides training depends on measures of international integration (exporting and foreign ownership), measures of technology and firm characteristics. They estimate this model on a cross section of manufacturing firms in Columbia, Indonesia, Malaysia, Mexico, Taiwan and China. They find a positive relationship between provision of training and exporting (in all countries except Malaysia) and foreign ownership (although this relationship is not robust to inclusion of several other firm characteristics). There are also several studies that examine the effect of other factors on the provision of training, but include measures of global engagement as control variables and find a positive relation between provision of training and international integration (Almeida and Aterido, 2008; Almeida and Aterido, 2010).

There is also survey evidence on the link between training and foreign ownership and supplying MNEs in transition countries. Djankov and Hoekman (1999) in their study of FDI productivity spillovers in Czech Republic show that 60% of the firms that are majority foreign owned and 47% of the firms that are minority foreign owned provided training to their employees compared with only 18% of the domestic firms. Deardorff and Djankov (2000) provide survey evidence that in a sample of manufacturing firms in Czech Republic 62% of the firms that are subcontractors of foreign firms provide training to their employees compared to only 27% of firms that are not subcontractors of foreign firms.

In conclusion, most of previous empirical studies the effect of international integration on the employment of skilled labour in transition and developing countries found mixed results. Also, these studies suggest that the results might depend on controlling for firm unobserved characteristics and also on the country characteristics, especially level of development and in the case of transition countries progress with the transition process. Most of previous econometric and descriptive studies on the effect of international integration on provision of training find that there is a positive relationship between firms' international integration and provision of training.

2.3 Conclusions

Overall, the literature suggests that in transition and developing countries the effect of globalisation on the demand for skilled labour is the result of two opposite effects: a positive effect due to skilled biased technology change facilitated by trade and FDI, outsourcing of goods which are more skill intensive than those already produced in developing countries and adoption of new technology in order to become more competitive in export markets, and a negative effect due to specialisation in goods intensive in unskilled labour. The overall effect is ambiguous.

The theoretical literature does not indicate which kind of workforce skills are most affected by globalisation. Most of previous empirical studies have focused on share of nonproduction employees. However, there is also some evidence that there is a positive relationship between participation in international activities and workforce education and training (Tan and Batra, 1996; Tan et al, 2007; Commander and Kollo, 2008; Fajnzylber and Fernandes, 2009; Almeida, 2010).

From a methodological point of view, the studies reviewed suggest that the effect international integration on the employment of skilled labour depends on whether or not the study controls for firm unobserved characteristics. Most of the studies that do not control for firm characteristics find a significant correlation between participation in international activities. However, Pavnik (2003) finds that the effect of international integration becomes insignificant when she controls for firm unobserved characteristics. None of the studies on training controls for firm unobserved characteristics, but it is possible that unobserved firm characteristics affect both provision of training and firm participation in international activities.

The empirical evidence suggests that the effect of globalisation on the employment of skilled labour in transition and developing countries is mixed, but that it is positive for the most developed developing countries. Given the level of development of transition economies and the available human capital in these countries, we would expect the effect for the whole sample to be positive. However, given that there are differences in the development between the countries in the sample, we will also examine whether the effect of globalisation on demand for skills differs between on groups of countries.

Table 1 Studies on participation in international activities and demand for skilled labour in developing and transition countries

Study	Country	Skill measures	Int. activity	Results
Harrison and Harris (1999)	Mexico (1984-1990)	Share of nonproduction employees	Foreign ownership Exporting Imported machinery Importing material inputs	Foreign ownership, exporting, imported machinery and material inputs are positively associated with the share of nonproduction employees.
Pavcnik (2000)	Chile (1979-1986)	Share of nonproduction employees	Foreign technical assistance, patent use, imports material inputs	Foreign technical assistance and importing material inputs are both positively associated with share of nonproduction employees, but this effect becomes insignificant when plant FE are included
Comander and Kollo (2008)	Hungary, Romania, Russia (1997-2000)	Share of employees with primary education Share of employees with vocational education Share of employees with secondary education Share of unskilled blue collar employees Share of skilled blue collar employees Share of white collar workers	Foreign Ownership (joint venture with a foreign firm) Exporting	<p>Hungary</p> <p>Foreign Ownership is positively associated with changes in share of employees with primary education and changes in share of unskilled blue collar workers and negatively associated with changes in share of employees with vocational education and skilled production employees.</p> <p>Exporting is positively associated with changes in the share of employees with primary education and with the share skilled production employees and negatively associated with changes in white collar employees.</p> <p>Romania</p> <p>Foreign ownership is positively associated with changes in the share on employees with vocational education, share of skilled blue collar employees and negatively associated with changes in the share of unskilled blue collar workers.</p> <p>Exporting is positively associated with the changes in the share employees with primary education, share of unskilled prod workers and negative associated with the changes in skilled production workers.</p> <p>Russia</p> <p>Foreign ownership is positively associated with changes in share of employees with vocational education and negatively associated with changes in share of employees with primary and secondary education.</p>

Fajnzylber and Fernandes (2009)	Brazil (2003) and China (2001)	Share of nonproduction employees Share of managerial, engineering and technical occupations Share of employees with some college education	Foreign ownership Exporting Importing material inputs	Brazil Foreign ownership, importing and exporting less than 50% of output are associated with higher share of nonproduction employees, higher share of managerial, engineering and technical occupation and higher share of employees with some college education, but exporting more than 50% is associated with a lower share of skilled labour China Foreign ownership is insignificantly associated the share of nonproduction employees, share of managerial, engineering and technical occupation and higher share of employees with some college ed. Exporting and importing are associated with lower shares of nonproduction employees, share of managerial, engineering and technical occupation and higher share of employees with some college education.
Almeida (2010)	Cambodia (2003), China (2002, 2003), Indonesia (2003), Malaysia (2002), Philippines (2003), South Korea (2005), Thailand (2004), Vietnam (2005).	Share of employees with more than secondary education Share of nonproduction employees	Foreign ownership Exporting	Foreign ownership is positively associated with the share of employees with more than secondary education and nonproduction employees. Exporting is negatively associated with share of skilled labour in China and low middle income countries and insignificantly associated with share of skilled labour in the other countries.
Tan, Savchenko, Gimpelson, Kapelyushnikov and Lukyanova (2007)	Russia (2005)	Formal training In house formal training External formal training	Foreign ownership Exporting	Foreign ownership is insignificantly associated with all types of formal training Exporting is positively associated with in-house and external formal training
Batra and Tan (1995)	Columbia (1993), Indonesia (1993), Malaysia (1995), Mexico(1993), Taiwan (1986)	Formal training In house formal training External formal training Skilled workers training Unskilled workers training	Foreign ownership Exporting	Foreign ownership is positively associated with formal training in Malaysia and positively associated with formal training in Taiwan. Exporting is associated with a higher likelihood of providing training in Colombia, Mexico, Indonesia (only for unskilled workers) and Taiwan.
Almeida and Aterido (2008)	66 developing countries (2002, 2005)	Formal training	Foreign ownership Exporting	Foreign ownership and exporting are both positively associated with a higher likelihood of providing training.
Almeida and Aterido (2010)	99 developing countries (2002-2007)	Formal training	Openness (foreign ownership or exporting)	Openness is positively associated with a higher likelihood of providing training

3 Data Description

In this section we will present the data used in the empirical analysis, describe the main variables related to labour skills and firms' international integration and present some preliminary evidence in support of our main hypothesis.

3.1 Business Environment and Enterprise Performance Survey 2002-2009

The data used in the empirical analyses comes from plant level dataset Business Environment and Enterprise Performance Survey (BEEPS) 2002-2009. This survey was conducted by the World Bank and European Bank of Reconstruction and Development (EBRD) with the objective to gather information on firms' performance and perception of the business environment in private sector in transition economies in ECA region.

The survey covers a wide range of topics, including workforce skills (workforce composition by education and occupation categories and provision of training), participation in international activities (foreign ownership, sales to MNEs located in the same country, exporting and importing) and other firm characteristics.

The implementation of the BEEPS 2002 and BEEPS 2005 was carried out by Synovate on behalf of the World Bank and EBRD. Their implementation is described in "The Business Environment and Enterprise Performance Survey (BEEPS) 2005: A brief report on observations, experiences and methodology from the survey" (Synovate 2005) and a similar report for 2002 wave. BEEPS 2009 was implemented by TNS Opinion in cooperation with local partners on behalf of the World Bank and EBRD. Its implementation is described in "The Business Environment and Enterprise Performance Survey (BEEPS) 2008-2009: A report on methodology and observations".

The survey uses standardised questionnaires and uniform sampling methods to generate internationally comparable data. Information about the plants' characteristics is gathered through interviews with the general manager of the plant and other members of the staff, for instance, accountants or human resources managers. BEEPS 2002 survey was conducted between 19th of June and 31th July 2002. BEEPS 2005 was conducted between 10th of March and 20th of April 2005. In these two surveys, most of the data, including data on participation in international activities, employment and labour force skills refers to the current year and data on formal training programmes refers to 2001 and 2004, respectively. BEEPS 2009 was conducted in during 2008 and 2009. In this survey, firms were asked to indicate their employment, labour force skills, formal training programmes and participation in international activities for the fiscal year 2007 (EBRD, 2010a). Therefore, for this wave all data refers to fiscal year 2007. To avoid confusion, we will refer to the year of the survey.

BEEPS 2002 and 2005 cover 26 transition economies in ECA region: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, FYROM, Moldova, Poland, Romania, Russia, Serbia and Montenegro, Slovakia, Slovenia Tajikistan, Ukraine and Uzbekistan². In addition to the countries covered in the previous waves, BEEPS 2009 also includes Montenegro, which became independent in 2006, and Kosovo. In the empirical analyses, we will include the firms from Montenegro because we can identify the firms in Montenegro in the previous surveys, but will exclude firms from Kosovo because they did not appear in the previous waves.

² Turkmenistan is not included because of lack of data.

Plants surveyed were selected from the population of registered plants in each country. The universe of firms was defined differently in BEEPS 2002 and 2005 and 2009. BEEPS 2002 and BEEPS 2005 cover firms with at least 2 full-time employees and less than 10000 full-time employees. BEEPS 2009 covers firms with at least 5 full time employees. In all the three waves plants that operate in health, education, welfare, public administration, agriculture, electricity, gas, water and water waste and financial intermediation sectors were excluded. In addition, BEEPS 2009 excluded firms in real estate and renting activities and other business services (group K in the ISIC Revision 3.1 classification) with the exception of the IT subsector (subsector 72) and firms in the other community, social and personal activities subsector (group O). BEEPS 2002 and BEEPS 2005 included only firms that started operation at least three years before the survey. BEEPS 2009 wave did not impose such requirements.

For BEEPS 2002 and 2005 quota sampling was used. In quota sampling, the population is first segmented into mutually exclusive sub-groups and then judgment is used to select the subjects or units from each segment based on a specified proportion. The survey used judgmental adjustments to provide a better subsector mix of the firms within industry and services sectors because they wanted the survey to reflect the performance and the perception of the business environment of different kind of firms in the private sector. For these two waves, the sample was segmented by sector and size category and in case of larger economies by region. The share of plants in industrial sectors³ and in service sectors is determined by the contribution of industrial and service sectors to the GDP in each country. The plant size categories used in these waves are: small (2 to 49 employees), medium (50 to 249 employees) and large (more than 249 employees). The number of employees was defined as the number

³ Industry is defined here as including manufacturing, construction and mining and quarrying (Synovate, 2002, 2005)

of full time permanent employees. The surveys aimed at including at least 10% of foreign firms⁴, 10% of state owned⁵ and at least 10% exporters⁶ and at least 10% of firms located in small towns/countryside⁷. However, in some countries, especially smaller or less developed economies these quotas and the quota for large firms could not be met mainly due to the small number of such firms. In these cases, the quotas were eased or completely removed (Synovate, 2002, 2005).

BEEPS 2009 survey is stratified by sector, size category and region. The stratification for the 2009 survey considers three sectors: industry, retail trade (subsector 52) and services, while the previous waves stratified the sample only by industry and services. The size categories are also different from the ones use in previous surveys: small (5 to 19 employees), medium (20 to 99 employees) and large (more than 99 employees). Priority was given to include firms which participated in BEEPS 2005 and met the eligibility criteria. An important difference between BEEPS 2009 and previous waves was that it did not impose any quotas for foreign owned or state owned, exporters, firms located in small towns or country side.

BEEPS 2009 also differs from BEEPS 2002 and 2005 with regard to questionnaire. Many questions are similar, but there are also differences. Most importantly, for our empirical analyses BEEPS 2009 does not gather information with regard to sales to MNEs located in the same country. Another important difference is that BEEPS 2009 wave used different questionnaires for manufacturing and for services firms. Many of the questions coincided, but firms in service sectors were not asked questions about their production and nonproduction

⁴ Firms were considered foreign if at least 50% of their capital was foreign owned (Synovate, 2002, 2005)

⁵ Firms were considered state owned if at least 50% of their capital was state owned(Synovate, 2002, 2005)

⁶ Firms were considered exporters if they exported at least 20% of their output (Synovate, 2002, 2005)

⁷ Small towns/ countryside was defined as a town with less than 50 000 inhabitants.

workers, their skilled production workers, training and the share of production and non production workers trained and the share of their inputs imported.

BEEPS 2002-2009 contains three cross sections: 2002, which contains 6153 plants, 2005, which contains 9098 plants, and 2009, which contains 9708 plants. It also contains three panel components: 2002-2005, which contains 1025 plants, 2005-2009 which contains 1561 plants and 2002-2005-2009 which contains 374 plants.

Table 7 presents the country composition of all the samples used in this study. The table show that the country composition is similar across the three cross sections and panels. However, in certain years the sample is very small for some countries. Only very few firms in Montenegro were interviewed in 2002 and in 2005 because at the time Montenegro was part of Serbia and Montenegro and the sample of firms was designed jointly for Serbia and Montenegro. Very few firms were interviewed in Albania in 2009, because another survey took place in the country the previous year and many of the firms interviewed did not wish to be interviewed again and the universe of firms with the desired characteristics was small. The composition across countries for the remaining countries is quite similar in the three waves. The panel 2002-2005 contains 1025 firms and its composition is similar to the composition of the 2002 and 2005 cross sections. Bosnia and Herzegovina and Montenegro do not appear in this panel. In Bosnia and Herzegovina the 2002 serial numbers were not available. The panel 2005-2009 contains 1561 firms. Albania and Montenegro are underrepresented due to reasons explained above. The panel 2002-2009 contains 374 firms. Like in the previous panels Bosnia and Herzegovina are not present at all and several of the largest countries in the sample like Poland and Russian Federation are underrepresented.

Table 8 shows the sector composition of the samples used in this study. The sector is defined is based on the 4 digit ISIC code of the main output as indicated by the firm. According the implementation notes on the survey this is the most accurate variable to classify firm by sector. In all the panels, we considered the sector of the firm the sector in which the firm operated first time it appears in the panel, although there are firms that change sector of activity. 2002 and 2005 samples are very similar in their sector composition. The main difference is that 2005 sample contains a larger share of manufacturing firms and a lower share of wholesale and retail trade firms than 2002 sample. BEEPS 2009 sample differs considerably from the previous two waves due the differences explained above. There are very few firms in the mining and quarrying sector and in the real estate, renting and business service sector because this wave excluded all firms in real estate and renting activities and other business services except IT. Firms in the other service category, which includes firms in the other community, social and personal activities, were also excluded in this wave. In addition, 345 firms did not indicate their ISIC code sector. It can be noticed that the sectoral composition of the panel 2002-2005 is similar to the 2002 cross section and the sectoral compositions of the panels 2005-2009 and 2005-2009 are similar to the 2009 cross section.

Table 9 show the size composition of the samples used in this study. For the size category, we use the classification in BEEPS 2009 survey. For the panels, we used the size of the firm when it first appears in the survey, although several firms changed their size over time. In some samples the number of observations is smaller than in the previous tables. This happens because not all the firms responded to the question regarding the number of employees. It can be noticed that break down by size categories is very similar in all samples. In almost all samples more than half of the firms have less than 20 employees, around 30% are medium

firms (have between 20 and 99 employees) and around 20% of the firms are large (have more than 100 employees).

Due to the fact that not all firms were asked all the questions relevant for our analysis and the fact that some firms did not respond to these questions, the number of observations which can be used in our empirical analysis is smaller than the number of observations reported in the previous tables. Table 10 presents the number of observations for each of the cross sections and panels used in this analysis and how the sample decreases as we include more variables. The panel samples include only observations that provide data for the main variables of interest in each wave.

The table shows that the sample is reduced considerably when we exclude observations that have missing values for international activities and basic control variables. The 2002-2009 panel in particular is reduced to just 95 observations. All the firms included in this panel are manufacturing except for one firm that is in the IT sector. The panel includes very few firms for each country. For many countries, including large countries like Poland and Russian Federation, there is just one firm per country. Given the small number of observations in this panel we will not use this panel in the empirical analysis. In the lower part of this table we show the number of observations for each of the cross section and panel and for which we also have information on the measures of workforce skills and on the international activities and basic control variables. These are the samples used in the baseline specifications in the empirical analysis.

3.2 Variable Definition

The definitions of the variables related to labour skills and international integration are presented in table below.

Table 2 Variable definition

Variable Name	Definition
<i>Share Skilled Labour</i>	
University education	Share of permanent full time employees with university degree.
Non production employees	Share of permanent full time employees that are managers, professionals and other nonproduction workers
Skilled production employees	Share of permanent full time production employees that were skilled production employees
<i>Training</i>	
Training	A dummy variable that takes the value 1 if the firm provided formal training programs for permanent full time employees.
Training non production empl.	A dummy variable that takes the value 1 if the firm provided formal training programs for permanent full time nonproduction employees.
Training production empl.	A dummy variable that takes the value 1 if the firm provided formal training programs for permanent full time production employees.
<i>International Integration</i>	
Foreign	A dummy variable that takes the value 1 if more than 10% of the firm's capital is owned by foreign investors and 0 otherwise.
MNE supplier	A dummy variable that takes the value 1 if the firm sells part of its output to MNEs located in the same country and 0 otherwise.
Exporter	A dummy variable that takes the value 1 if the firm exports part of its output (directly or indirectly) and 0 otherwise.
Importer	A dummy variable that takes the value 1 if the firm imports part of its material inputs (directly and indirectly) and 0 otherwise.
International Activities	A dummy variable that takes the value 1 if the firm is foreign, or supplies MNEs located in the same country, or exports or imports and 0 it is not involved in any of these activities.

There are a few things that should be noted about the construction of the variables and differences between different waves of the surveys.

Our measure of university education is the share of employees with university education in total employees and it is based on question ecaq69 in BEEPS 2002-2009 panel dataset.

Share of nonproduction employees is the share of managers, professionals, and other nonproduction employees (like administration, sales) in total employment. This measure is frequently used in studies on this topic. The BEEPS panel dataset 2002-2009 contains information on the number of production and nonproduction permanent full time employees and the total number of permanent full time employees, based on which we calculate the share of nonproduction employees.

The share of skilled production employees in total production employees is calculated based on the information on the number of skilled production employees and the number of total production employees in BEEPS panel dataset. The exact question in BEEPS 2009 is: “(...), , how many permanent, full time employees were skilled production workers?”. The surveys did not include a definition of skilled production workers and from the question is not clear whether skilled production workers refers only to workers that have a formal qualification suitable for their occupation, like for instance vocational training, or also to other workers. Since the question refers to occupational categories and it distinguishes between skilled and unskilled workers, we consider that it refers to workers that are employed as skilled production workers and have acquired some skills relevant for their jobs, but I do not make any assumptions about their education.

Firms were asked whether or not the firm offers formal training to their employees and the percentage of employees in each occupational category that received training over the last 12 months. The exact question is: “Over (...), did this establishment have formal training programs for its permanent, full-time employees?”. From this question, it is unclear which the type of training is offered by the firm and whether it leads to formally accredited certificate or not. Since the question refers to training offered by the firm we assume that it leads to the

acquisition of skills relevant for the employees' job. In addition, since it refers to formal training, we assume that it refers to training beyond informal, on the job training. Other studies that used this dataset interpreted the question the same way (Almeida and Aterido, 2010, 2008).

Firms were also asked to indicate the percentage of employees in each occupational category that received training over the last 12 months. Not all the firms that answered the question on whether or not they provided training indicated the shares of production or nonproduction workers that received formal training. Therefore, there are more observations for the variable training than for the variables training of production employees and training of nonproduction employees. There were also cases of firms that answered that they provide training but indicated that shares of production and nonproduction workers that received training are both 0. In these cases, we considered that the answer to the question was mistaken and the firm did not provide training. There were also cases of firms that answered that they did not provide training and did not answer the questions about the shares of workers trained. In this case, I also considered that the shares are 0. Finally, there are some cases in which the firms answer that an unrealistically small share of workers received training. For instance, there was one firm that answered that 3% of its 12 nonproduction employees received training. In the EBRD description of the implementation of the survey (EBRD, 2010a), it was reported that several firms found it difficult to indicate the exact % of employees that received training, although they knew whether or not the firm had a training program. Therefore, we focus on the provision of training and on what type of employees (production or nonproduction employees) that received training and not on the intensity of training (the share of employees that received training).

With regard to measures of international integration, most of the questions were similar in all surveys. The main differences between the BEEPS 2009 and the previous waves are that in BEEPS 2009 the question about supplying MNEs located in the same country was not asked and only manufacturing firms were asked the question about imported inputs.

3.3 *Descriptive Statistics on Participation in International Activities*

In this subsection we will look at the participation of firms in four international activities. Table 3 presents descriptive statistics for the three cross sections and for the two panels for the variables related to participation in international activities. Each panel includes only firms that appear in all the years of the panel and provide data for all the main variables of interest.

Table 3 Participation in international activities –summary statistics

	Foreign	MNEs supplier	Exporter	Importer	International Activities
Cross section 2002	0.17	0.15	0.27	0.56	0.66
Cross section 2005	0.11	0.14	0.23	0.49	0.60
Cross section 2009	0.14		0.39	0.61	0.76
Panel 2002-2005					
2002	0.15	0.15	0.25	0.57	0.67
2005	0.12	0.14	0.23	0.50	0.60
Panel 2005-2009					
2005	0.16		0.43	0.63	0.71
2009	0.17		0.40	0.68	0.76

Source: BEEPS 2002-2009

The table shows that the share of foreign owned firms is decreasing from 2002 to 2005. This could be due to different quotas of foreign firms of the BEEPS waves. BEEPS 2002 wave aimed to include 15% of foreign owned firms. However, due to the small universe of such firms in several countries, especially smaller ones and less advanced in their transition, the quota was reduced to 10% and in some cases it was reduced even further. BEEPS 2005 aim to include at least 10% of foreign owned firms, but in case this share was difficult to achieve the quota was reduced. BEEPS 2009 did not aim to include a certain share of foreign owned firms. The 2002 and 2005 cross sections and also the 2002-2005 balanced panel show that the share of firms that supply MNEs located in the same country is 15% in 2002 and it remains

almost unchanged in 2005. In the BEEPS 2009 wave firms were not asked whether they sell part of their output to MNEs. Looking at the share of exporters in the three cross sections, it seems that the share of exporters in the sample decreases slightly from 2002 to 2005 and then increases considerably from 2005 to 2009. In 2009 this share is much higher than in previous years because the 2009 sample is restricted to manufacturing firms, which are more likely to export than service firms and therefore the data is not comparable with the other waves. Actually, the balanced panel that covers the 2005-2009 period shows that the share of exporters slightly decreased over this period. Importing is the most common international activity undertaken by the firms in all samples and years. In all samples almost half of the firms import part of their material inputs. The share of firms that imports decreased from 2002 to 2005, but it increases from 2005 to 2009. Again, the fact that only manufacturing firms are included in the 2009 cross section and in the 2005-2009 panel explains why in these samples the share of firms that import is much higher than in the other samples. In the last column we show the share of firms that participates in any of the four international activities considered. In all samples, large shares (more than 60%) of firms participate in some international activity.

Next, we look at changes in participation in international activities. It is important to look at these changes because fixed effects estimation and difference in difference estimation, which we use in our empirical analyses, use these changes to identify the effect of participation in international activities on skill upgrading. The following table presents the shares of firms that change their participation in international activities. Table 4 shows the shares of firms that never participate in any international activities, those that participate continuously and those that start and quit participating in such activities, during the periods 2002-2005 and 2005-2009.

Table 4 Changes in participation in international activities

	Foreign ownership		Supplying MNEs		Exporting		Importing		International activities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Firms	Share	Firms	Share	Firms	Share	Firms	Share	Firms	Share
Panel 2002-2005										
Never participated	645	0.83	594	0.76	540	0.69	252	0.32	189	0.24
Starter	15	0.02	65	0.08	41	0.05	84	0.11	71	0.09
Always participated	78	0.10	44	0.06	141	0.18	308	0.40	391	0.50
Stopped being foreign	39	0.05	74	0.10	55	0.07	133	0.17	126	0.16
Total	777	1.00	777	1.00	777	1.00	777	1.00	777	1.00
Panel 2005-2009										
Never participated	445	0.77			287	0.50	118	0.20	87	0.15
Starter	35	0.06			42	0.07	97	0.17	81	0.14
Always participated	63	0.11			191	0.33	295	0.51	356	0.62
Stopped being foreign	35	0.06			58	0.10	68	0.12	54	0.09
Total	578	1.00			578	1.00	578	1.00	578	1.00

Source: BEEPS 2002-2009

Table 4 (columns 1 and 2) shows that most of the firms do not change their ownership. 83% of firms are domestic owned during 2002-2005 period and 10% of firms are foreign owned throughout the period. For the 2005-2009, these proportions are 77% and 11%, respectively. It is surprising that in the 2002-2005 panel there are more firms that change ownership from foreign to domestic (5%) than from domestic to foreign (2%). In the 2005-2009 panel the shares of firms that change their ownership from domestic to foreign and the share of firms that changes their ownership from foreign to domestic are equal (6%). The small number of firms that changes ownership in the two panels suggests that it will be difficult to identify the effect of changes of foreign ownership on skill upgrading.

Table 4 (columns 3 and 4) shows the shares of firms that never supplied MNEs, of firms that started supplying MNEs, firms that stopped supplying MNEs and firms that supplied MNEs continuously during the 2002 - 2005 period. Between 2002 and 2005 most of the firms (more than 75%) do not supply MNEs located in the same country. The share of entry into supplying MNEs and share of firms that exit from supplying MNEs are large. Actually, these shares are larger than the share of firms that continue supplying MNEs throughout the period 2002-2005, which suggest that a large part of the firms that supply MNEs participate only temporarily in this activity.

Table 4 (columns 5 and 6) shows the shares of firms in the sample that change their export status during the periods 2002-2005 and 2005-2009. During the 2002-2005 period almost 70% of the firms never exported. During this period there are large shares of firms that enter and exit exporting. The share of firms that exit exporting is higher than the share of firms that enter exporting. Also, the share of firms that continue exporting throughout the period is higher than the shares of firms that start or quit exporting, consistent with the previous

finding in the literature on the persistence of exporting. For the 2005-2009 balanced panel sample, a higher share of firms exports continuously (33%, as compared to 18% in the 2002-2005 sample) and the shares of firms that entry or exit exporting are also higher. This is probably due to the large share of manufacturing firms in this panel.

Columns 7 and 8 in Table 4 present the shares of firms in the sample that change their import status during the periods 2002-2005 and 2005-2009. A large share of the firms is imports continuously (40% in 2002-2005 panel and 51% in 2005-2009 panel). In both panels there are high rates on entering and exiting importing.

Table 4 reports in columns 9 and 10 the shares of firms in the sample that never participate in any international activity, firms that started, continued or stopped participating in international activities during the periods 2002-2005 and 2005-2009. In both samples large shares of firms (more than 50%) participate always in some international activity and there are also large entry and exit rates into participation in international activities.

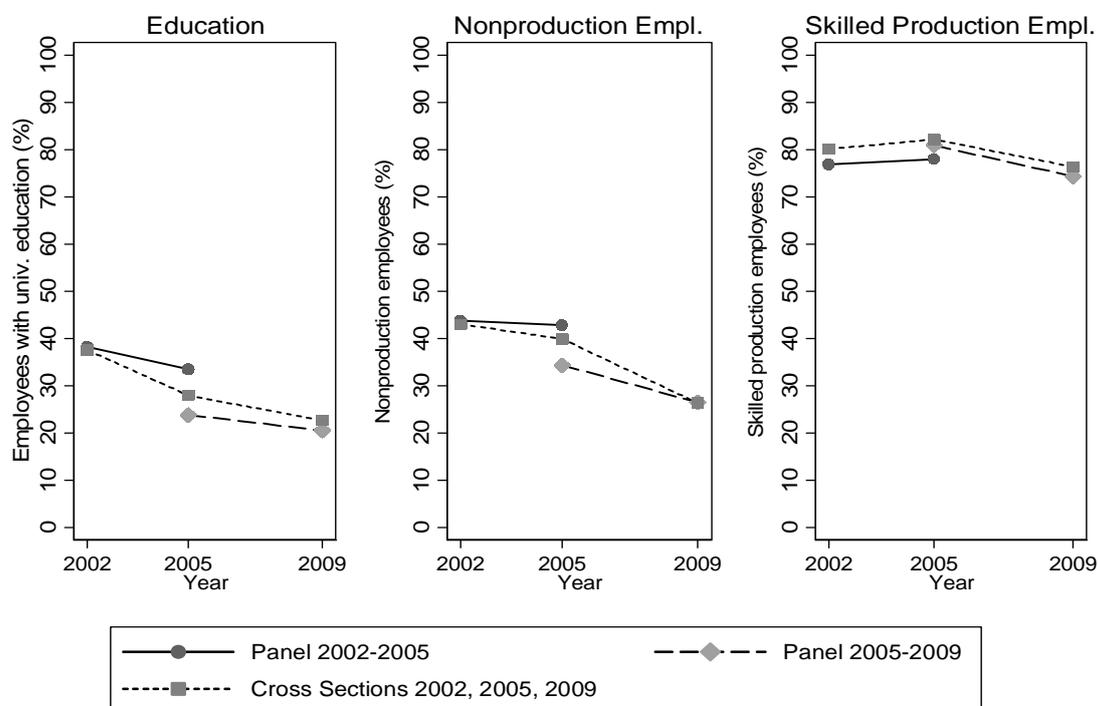
In conclusion, there are high entry and exit rates in participating in international activities in general, but for some individual activities like FDI these rates are small. This suggests that we can use fixed effects and difference in difference estimation methods to study the effect of international integration on demand for skills, but for some specific international activities it will be difficult to identify this effect.

3.4 Descriptive Statistics on Labour Skills

In this subsection we will examine changes in labour skills over the period 2002-2009 to understand how the labour skills evolved over this period and to examine whether there are differences between different samples used in the empirical analysis. The summary statistics for each measure of labour skills in each of the cross section and panels use in the study are reported in Table 12 in the annexes. Here we will present the evolution of these measures graphically.

Figure 1 presents the changes over time in the share of employees with tertiary education in total employees, the share of nonproduction employees in total employees and the share skilled production employees in total production employees over the period 2002-2009 using the 2002, 2005 and 2009 cross section and the 2002-2005 and 2005-2009 panels.

Figure 1 Changes in skilled labour shares 2002-2009



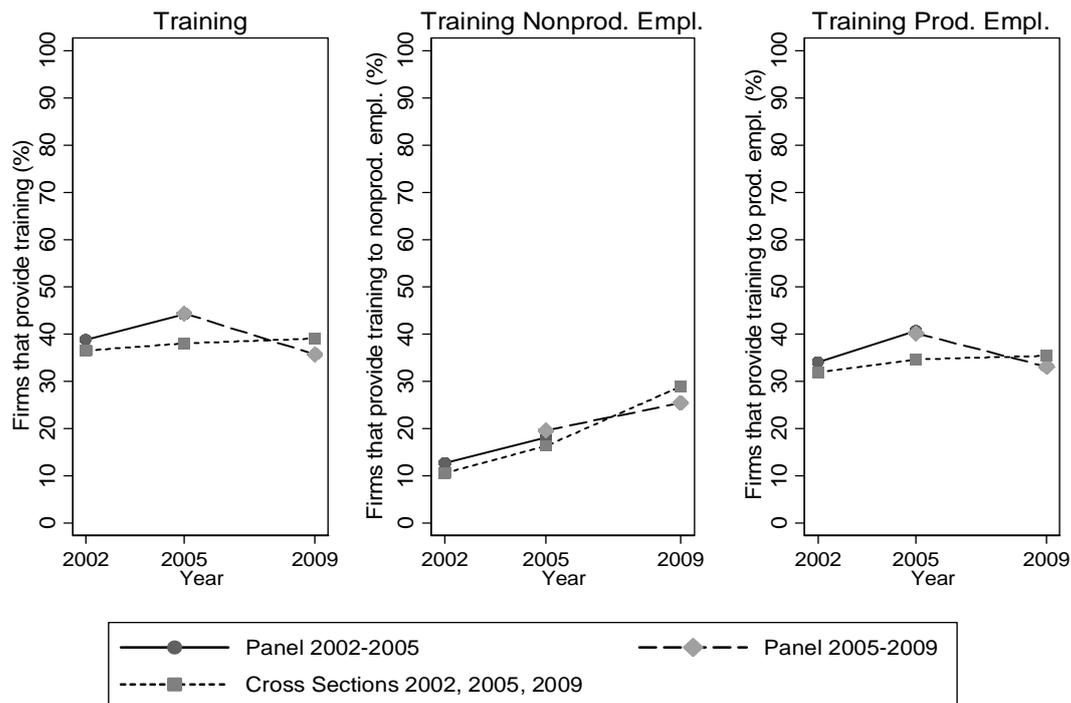
Source: BEEPS 2002-2009

The 2002, 2005 and 2009 cross-sections and also the balanced panels 2002-2005 and 2005-2009 show similar patterns for all three measures. The figures suggest that the average share of employees with tertiary education, the average share of nonproduction employees in total employees and the average share of skilled production workers decrease over time. This pattern is surprising, especially in view of fact that in most of the countries studied labour supply with tertiary education increased slightly over the period, as shown in Table 13 (in annexes), which reports the percentage of labour force with tertiary education from World Bank Development Indicators.

A possible explanation for this evolution of the workforce skills over 2002-2009 period is the restructuring of firms. Most of the firms started the transition process overstaffed for the needs of a market economy and in order to become competitive they reduced redundant labour (World Bank, 1996). This process was prolonged and was ongoing during the period studied (Rutkowski, 2007). Finally, another possible explanation is that the data is not very precise. For instance, in the report of the implementation of the survey for 2002 in Bulgaria it is mentioned that due to the high level of unemployment in the country workers often perform duties below their education level. Managers did not care about their level of education and, therefore, they sometimes provided only rough estimates of the percentage of employees with tertiary education, which could be very noisy. There were no similar notes for any other country in the sample; however, many countries were in a similar situation and it is possible that this problem existed also in other countries. To address this potential problem, in our empirical analysis we will consider the robustness of our findings to the use of several measures of workforce skills.

Figure 2 presents the share of firms that provide formal training, the share of firms that provide formal training to nonproduction employees and the share of firms that provide training to production employees, in the three cross sections and in the 2002-2005 panel and the 2005-2009 panel.

Figure 2 Changes in personnel training 2002-2009



Source: BEEPS 2002-2009

The figures show that the share of firms that provides training to their employees increases from 2002 to 2005, but then decreases in 2009. Regarding the training provided to production or nonproduction workers, it can be noticed that in all samples and in all years the share of firms that provides training to production workers is much higher than the share of firms that provides training to nonproduction workers. In terms of evolution over time, it can be noticed that all the cross sections and panels show that the share of firms that provided training to nonproduction workers increased during 2002-2009 period. The share of firms that provided training to production workers increased from 2002 to 2005, but from 2005 to 2009 it decreased.

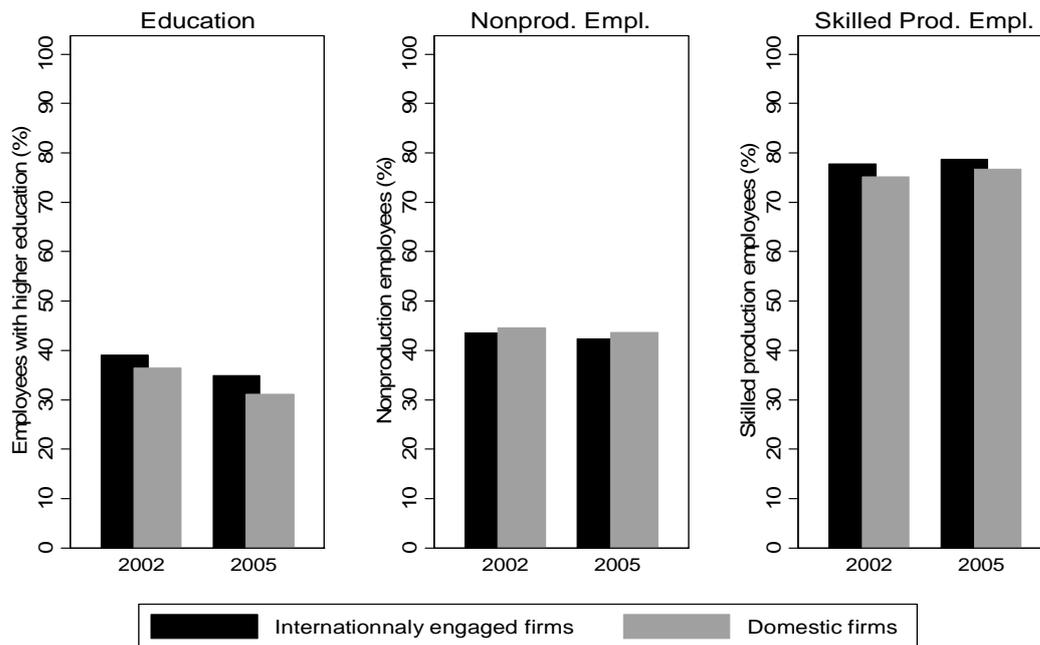
In conclusion, we find that the cross sections and the two balanced panels show a similar evolution of our main indicators of workforce skills. All of them suggest that share of employees with tertiary education, the share of nonproduction employees and the share of skilled production employees decreased between 2002 and 2009 and that the share of firms that provides training increases between 2002 and 2005, but then decreases between 2005 and 2009.

3.5 Skills and Participation in International Activities

In this section, we examine how skill upgrading varies across firms which are involved in international activities. For expositional purposes, we will focus on the differences between firm that engaged in at least one of the international activities and firms that do not participate in any international activities in the balanced panel sample for 2002-2005, which is the main sample used in the empirical analysis. In Table 14 and in Table 15 the annexes, we report the differences with regard to labour skills between domestic firms and foreign owned firms, MNEs suppliers, exporter and importers for all the cross sections and the panels used in the empirical analysis. It is important to mention that the categories foreign owned, MNEs supplier, exporter and importer, which are defined in Table 2, are not mutually exclusive. For instance, if a firm is foreign owned and it also exports it will appear in both categories. Domestic firms are firms that do not participate in any of the international activities considered.

Figure 3 shows the shares of employees with tertiary education, the share of nonproduction employees and the share of skilled production employees in domestic and internationally engaged firms.

Figure 3 Skilled labour shares in internationally engaged firms and in domestic firms

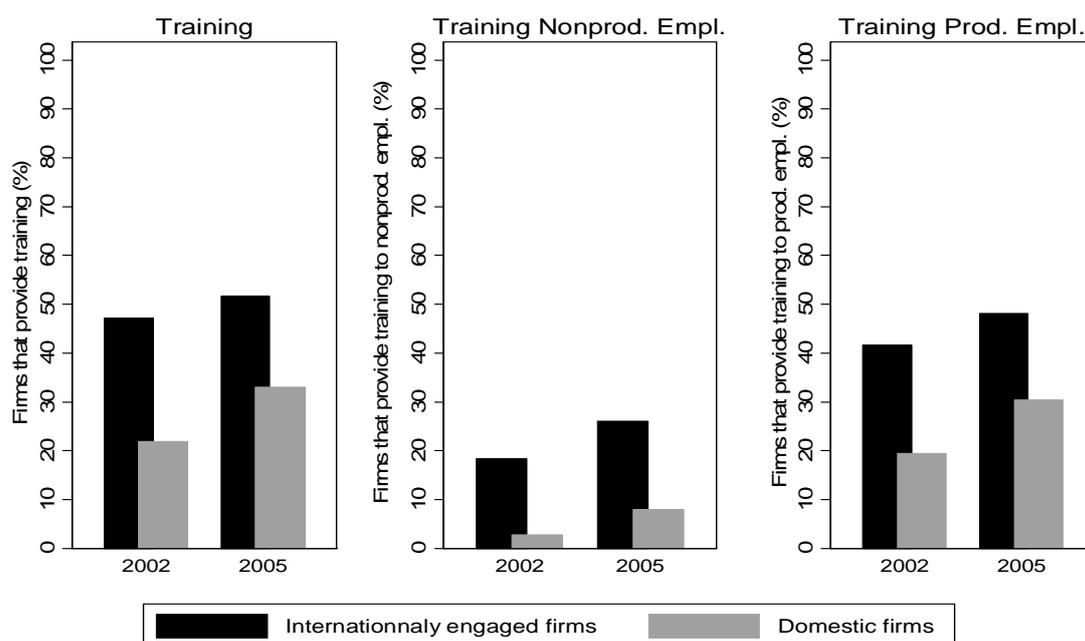


Source: BEEPS 2002-2009

The figure shows that differences between firms engaged in international activities and domestic firm with regard to the share of employee with tertiary education, share of nonproduction employees and share of skilled production employees are small. These differences are statistically insignificant. Between 2002 and 2005, the share of employees with tertiary education decreased for both domestic and internationally engaged firms. The share of nonproduction employees and the share of skilled production employees changes very little between 2002 and 2005 for both categories of firms.

Figure 4 shows the share of internationally engaged firms and share of domestic firms that provide training to their employees in general, to their nonproduction employees and to their production employees.

Figure 4 Personnel training in internationally engaged firms and in domestic firms



Source: BEEPS 2002-2009.

Compared to domestic firms, firms that participate in international activities are much more likely to provide formal training, to provide formal training to nonproduction and to production employees. The differences between domestic and internationally engaged firms with regard to provision of training are large and statistically significant. These differences are particularly large for provision of training for nonproduction employees. Between 2002 and 2005 the share of firms that provides training increases for both categories of firms, but increases most for domestic firms.

Table 14 and Table 15 show that firms engaged in different international activities differ little among themselves and also from domestic firms with regard to the share of employees with higher education, share of nonproduction employees and share of skilled production employees, except that foreign owned firms which have a higher share of employees with tertiary education. Also firms engaged in different international activities differ with regard to provision of training but all of them are more likely to provide training than domestic firms.

Firms engaged in different international activities also show skill upgrading pattern over time. Between 2002 and 2009 the share of university employees, the shares of nonproduction employees and of skilled production employees decrease for all international activities and also for domestic firms. The share of firms that provides training to nonproduction employees increases for all categories of firms throughout the period. However, they differ with regard to provision of training for production employees. The share of firms that provide training to production employees increases for all firms between 2002 and 2005, but between 2005 and 2009 it increases only for foreign owned firms and it decreases for importers and exporters.

In conclusion, this preliminary evidence shows that compared to domestic firms, firms that participate in international activities do not differ much in terms of workforce education and the shares of nonproduction employees and skilled production employees but differ considerably in terms of provision of training. Firms engaged in international activities are more likely to provide formal training to their employees (both production and nonproduction employees) than purely domestic firms and these differences are large.

4 Empirical Strategy

To study formally the relationship between skill upgrading and international integration, we follow the methodology used in previous studies (reviewed in section 2.2). We estimate a specification in which measures of labour skills are regressed on measures of international integration, measures of technology and other firm characteristics:

$$Skill_{it} = \alpha I_{it} + \beta T_{it} + \gamma Z_{it} + \mu_i + u_{it} \quad (1)$$

i represents the firm and t represents the time. $Skill_{it}$ represents labour skills. The measures of labour skills used are defined in Table 5.

I_{it} represents global integration of firms. The measures of international integration are: foreign ownership, supplying MNEs, exporting and importing and are defined in Table 5. A positive and significant coefficient α suggests that international integration is associated with higher demand for skilled labour. Because many firms participate in several international activities simultaneously, including all the measures of international integration in the same specification may create multicollinearity problems. Therefore, we will also estimate a variant of this specification in which our measure of international integration is a dummy variable that takes value 1 if the firm is engaged in international activities and 0 if it does not participate in any such activities.

T_{it} represents firm's technology. Adoption of new technology is likely to affect workforce skills because it may require better skilled workforce. It may also increase the probability of the firm participating in international activities if it improves the cost or quality of its products. Therefore, not including controls for technology might lead us to overestimate the effect of the participation in international activities on demand for skills. However, if participating in international activities leads to adoption on new skill intensive technology, as studies like Yeaple (2005) and Bustos (2007) suggest, then controlling for technology adoption would bias down the coefficients of international activities. Ideally, we would like to control for the technology of the firm before it started participating in international activities, but we do not have this information. Therefore, we will also estimate the equations both with and without controls for technology adoption and we will examine how the inclusion of controls for technology affects the coefficients of international activities. Technology is measured as a dummy variable that takes the value 1 if the firm introduced new products or upgraded its existing products in the previous three years. Similar controls for technology were used by Commander and Kollo (2008) and Almeida (2010). Another

variable that has been commonly used to control for firm's technological efforts in similar studies is investment in R&D. However, in the BEEPS 2002 wave only 30% of the firms answered the question regarding investment in R&D. Previous studies also found that the use of ICT (Autor, Katz and Krueger, 1998; Doms, Dunne and Troske, 1997) and product quality (Commander and Kollo, 2008; Almeida, 2010) are associated with better skilled labour force. In our robustness checks we will also include controls for the use of ICT and quality. Our measure of the use of ICT is a dummy variable that takes the value 1 if the firm uses email and 0 otherwise, similar to the one used by Almeida (2010). Our measure of quality is a dummy variable that the value 1 if the firm has an internationally recognised certificate and 0 otherwise, which was used also by Commander and Kollo (2008) and by Almeida (2010).

Z_{it} are other firm characteristics which may affect skill intensity and international integration. We will include controls for size, age, state ownership, year, country, sector and city fixed effects to control for year, country, sector and city specific factors that influence the skill intensity of the firms. We do not have information on the region in which the firms are located within a country, but we have information on whether the firms are located in capital city, a city with more than 1 million inhabitants, a city with a population between 250000 and 1000000 inhabitants, a city/ town with a population between 50000 and 250000 inhabitants and a city/town with less than 50000 inhabitants. When the dependent variable is training of nonproduction employees or training of production employees we also include measures of workforce skills (share of employees with higher education and share of skilled production employees, respectively) in order to test whether training substitutes or complements these skills.

Equation (1) includes also firm fixed effects (μ_i), which capture firm unobserved characteristics. It is important to control for these characteristics because the participation in international activities could be correlated with unobserved plant characteristics that also affect workforce skills. For instance, it is likely that managerial ability affects both the skills of the workforce and participation in international activities. Few studies on the relationship between globalisation and skill control for firm unobserved characteristics. However, the results of the studies that control for them suggest that these effects are important. Pavcnik (2003) finds that firms engaged in international activities have better skilled workforces, but that the effect of participation in international activities on skill upgrading becomes insignificant when she controls for firms' unobserved characteristics. Similarly, Doms Dunne and Troske (1997) find similar results for adoption of new technology. Therefore, we consider that it is important to control for firms' unobserved characteristics.

We assume that the relationship between labour skills measures and participation in international activities and the other control variables can be expressed as a linear function, despite the fact that our dependent variables are shares and dummy variables, because this allows us to include firm fixed effects.

Controlling for firm fixed effects is important for the reasons explained above; however using fixed effects (FE) also presents several disadvantages. One of the main disadvantages of using FE is that it imposes the restrictions that starting an international activity and stopping this activity have an equal and opposite effects on demand for skills. In addition, using FE especially on a short panel (both our panels are short-3 years) may exacerbate measurement errors, which can bias coefficients towards 0. To address these problems, we will also estimate a specification which allows starting, continuing and quitting to participate in an

international activity to have different effects on demand for skilled labour. This specification also allows us to examine whether firms with better skilled workforce select into participation in international activities. In this specification we will not use all measures of participation in international activities because controlling for starting, continuing and stopping to participate in each of the four international activities may create multicollinearity problems. We will use only the measure which indicates whether or not a firm participates in international activities.

We will estimate the following specification for the panel 2002-2005:

$$Skill_{it} = \alpha_1 StartI_{it} + \alpha_2 ContI_{it} + \alpha_3 StopI_{it} + Year2005 + \alpha_4 StartI_{it} * Year2005 + \alpha_5 ContI_{it} * Year2005 + \alpha_6 StopI_{it} * Year2005 + \beta T_{it-1} + \gamma Z_{it-1} + u_{it} \quad (2)$$

I_{it} is a measure of participation in international activities and it is defined as dummy variable that takes value 1 if the firm is engaged in international activities and 0 if it does not participate in any such activities. $StartI_{it}$, $ContI_{it}$ and $StopI_{it}$ represent dummy variables that indicate whether a firm started participating, participated continuously or stopped participating in international activities during 2002-2005, respectively. In this equation the coefficients α_1 shows the differences in workforce skills in 2002 between the firms that started to participate in an international activity between 2002 and 2005 and firms that did not participate in the any international activity during this period. Coefficient α_2 shows the difference in the workforce skills in 2002 between firms that participated continuously in an international activity during the 2002-2005 and firms did not participate in any international activity during this period. If firms with better skilled workforces select into participating in international activities than coefficients α_1 and α_2 should be positive and significant. Interactions between these variables and year 2005 dummy variables indicate how the workforce skills of the given category of firms changed between 2002 and 2005 relative to the workforce skills in 2002. The main coefficients of interest are α_4 and α_5 . If our hypothesis that firms upgrade the skills of their workforce after starting to participate in international

activities is correct, then the coefficients α_4 and α_5 should be positive and significant. T_{it-1} represents firm technology at the beginning of the period. Z_{it-1} represent the firm characteristics (we control for the same characteristics as in equation (1)) at the beginning of the period.

We will estimate equations (1) and (2) on the samples for which we have balanced panels for 2002-2005 and 2005-2009 periods. As explained in the data description section, we cannot use the 2002-2009 panel because of the very few number of observations and because it is not representative.

5 Estimation Results

5.1 Baseline Results

We start by estimating equation (1) on the balanced panel 2002-2005 using pooled OLS. The results for the main variables of interest are reported in Table 5.

Table 5 Labour skills and international integration (balanced panel 2002-2005, pooled OLS)

	Education	Nonprod	Skilled prod empl.	Training	Training nonprod. empl	Training prod. empl.
International	0.072***	0.041**	0.024	0.127***	0.097***	0.144***
Activities	(0.018)	(0.018)	(0.021)	(0.027)	(0.028)	(0.033)
Innovation	0.022	-0.001	-0.001	0.110***	0.071***	0.100***
	(0.016)	(0.017)	(0.020)	(0.027)	(0.028)	(0.032)
Obs.	1288	1518	1194	1554	800	1168
R^2	0.386	0.286	0.128	0.187	0.282	0.209

Notes: All the estimations include controls for other firm characteristics and year, country, industry and city fixed effects. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

The OLS results show that participation in international activities is positively and statistically significantly associated with share of employees with tertiary education, share of nonproduction employees and provision of training in general, provision of training for nonproduction employees and provision of training for production employees. These results show that firms that are engaged in international activities have a better skilled workforce in

terms of education and also of occupation and also that these firms are more likely to provide training to their employees than firms which are not engaged in international activities. The magnitude of the coefficients imply that participating in international activities increases the probability of providing formal training by almost 13%, the probability of providing training to nonproduction employees by 10% and the probability of providing training to production employees by almost 14%.

Introduction of new products or upgrading new products is insignificantly related to the share of employees with tertiary education, share of nonproduction employees and the share of skilled production employees, but it is positively and significantly associated with all measures related to provision of training. Introduction of new products and upgrading of existing products increases the probability that a firm provides formal training by 6% for nonproduction employees and by 10% for production employees. The coefficient of the year dummy suggests that the share of employees with tertiary education decreased between 2002 and 2005, the share of nonproduction employees and the share of skilled production employees did not change significantly and the likelihood that a firm provides training to its employees increased over this period. Size category dummies are negatively related to the share of employee with tertiary education and to the share of nonproduction employees, insignificantly related to the share of skilled production workers and positively and significantly related to all measures of training. The share of employees with university education is positively and significantly associated with provision of training for nonproduction employees and the share of skilled production employees is positively and significantly associated with provision of training for production employees, which suggests that the training and education/skills are complements rather than substitutes. Location dummies suggest that firms located in capital cities or cities with over one million inhabitants

have a better skilled workforce according to all measures and also are more likely to train their employees. The country dummies imply that firms in most CEE countries have a lower share of employee with tertiary education and also of nonproduction employees, but more likely to provide training to their employees than firms in CIS countries.

Next we study whether our results are robust to controlling for firm unobserved characteristics. As mentioned above, participation in international activities could be correlated with unobserved plant characteristics, like managers ability, that also affect workforce skills. We report the results of estimating equation (1) using FE in Table 6.

Table 6 Labour skills and international integration (balanced panel 2002-2005, Fixed Effects)

	Education	Nonprod	Skilled prod. empl.	Training	Training nonprod. empl	Training prod. empl
International	0.007	0.005	-0.018	0.075*	0.060	0.112**
Activities	(0.019)	(0.024)	(0.030)	(0.043)	(0.043)	(0.050)
Innovation	-0.026	-0.050**	0.019	0.059	0.048	-0.011
	(0.017)	(0.021)	(0.026)	(0.037)	(0.038)	(0.044)
Obs.	1288	1518	1194	1554	800	1168
R^2	0.861	0.753	0.676	0.625	0.738	0.673

Notes: All the estimations include controls for other firm characteristics and year, country, industry and city fixed effects. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

The FE estimation results show that when we control for firms' unobserved characteristics, the effect of international activities on share of employees with tertiary education and nonproduction employees and provision of training for nonproduction employees becomes insignificant. Similarly, the effect of introducing new products/ upgrading existing ones on provision of training becomes statistically insignificant. These results suggest that firms with better skilled workforce and firms that train their nonproduction employees are more likely to select into participating in international activities, but they do not upgrade the skills of their workforce after becoming internationally integrated. The results are similar to the results obtained by studies on this topic that used panel data and controlled for firm unobserved characteristics, like Pavcnic (2003) and Doms et al. (1997). However, the results for

provision of training and for provision of training to production employees remain positive and statistically significant after controlling for firm unobserved characteristics.

Next we examine whether starting, continuing and quitting to participate in an international activity have different effects on demand for skilled labour. We do this by estimating equation (2). The results are presented in Table 7.

Table 7 Labour skills and changes in participation in international activities (balanced panel 2002-2005, with control variables)

	Tertiary Education	Nonprod. empl.	Skilled prod. empl.	Training	Training nonprod. empl.	Training prod. empl.
Starter	0.054 (0.040)	0.000 (0.039)	0.013 (0.047)	0.087 (0.063)	0.010 (0.069)	0.102 (0.075)
Starter* Year2005	-0.006 (0.055)	0.039 (0.054)	-0.043 (0.065)	-0.028 (0.087)	0.018 (0.094)	-0.070 (0.103)
Cont.	0.092*** (0.027)	0.050* (0.027)	0.026 (0.032)	0.195*** (0.043)	0.116** (0.045)	0.194*** (0.051)
Cont.*Year2005	0.002 (0.035)	0.004 (0.035)	0.030 (0.042)	-0.078 (0.055)	-0.002 (0.058)	-0.073 (0.066)
Exiter	-0.049* (0.029)	-0.026 (0.030)	-0.004 (0.036)	-0.053 (0.047)	-0.059 (0.052)	-0.001 (0.057)
Exiter*Year2005	-0.017 (0.046)	0.018 (0.045)	0.012 (0.055)	-0.167** (0.072)	-0.087 (0.078)	-0.253*** (0.087)
Obs.	1288	1518	1194	1554	800	1168
R^2	0.374	0.285	0.129	0.224	0.289	0.221
Starter*Y2005=-Exiter*Y2005 (F test, p value)	0.780	0.478	0.755	0.134	0.624	0.038
Starter =Cont. (F test, p value)	0.301	0.178	0.757	0.068	0.102	0.188

Notes: All the estimations include controls for other firm characteristics and year, country, industry and city fixed effects *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

The results from DID estimation show similar results for all our measures of skills, skilled production employees which are not significantly affected by any change in the participation in international activities. The results show that firms that start participating in international activities do not upgrade the skills of their labour force through increasing share of employees with university education or nonproduction employees or by training their employees after starting participating in international activities.

This specification also allows us to possibility to examine the hypothesis of selection of firms with better skilled workforce in participating in international activities. The results show that firms that participate continuously in international activities during 2002-2005 have a better skilled workforce than firms that never participate in international activities. The coefficient of participating continuously in international activities is positive and significant for measures of workforce skills, except skill production employees. The magnitude of the coefficient is large for most of the measures of workforce skills. This evidence is consistent with the selection of best firms into participation in international activities. The coefficient of the firms that will start participating in international activities between 2002 and 2005 is positive, and its magnitude is large in the specification in which dependent variables are training and training of production employees, but it is not statistically significant. It is possible that this coefficient is poorly determined and biased towards 0 because of the short period of time and because of small sample. At the bottom of Table 7 we show the results of the test of the equality of the coefficients of starting to participate in international activities and of participating continuously in such activities. The test never rejects the hypothesis that the two coefficients are equal. This is also suggestive of selection of firms with better skilled workforce in participating in international activities.

We also test whether the coefficients of starting to participate in international activities and quitting participating in such activities are equal in magnitude but have opposite signs. The results of these tests are also reported in Table 7. We find that we cannot reject this hypothesis and therefore the results of FE estimation are not biased due to imposing this restriction.

Taken together, the results of the pooled OLS, FE and DID estimations results suggest that firms engaged in international activities have a better educated labour force more nonproduction employees and they are more likely to train their production and nonproduction employees than domestic firms, but that there is no causal link between participation in international activities and skills or training. On the contrary we find evidence that firms with better skilled workforce select into participation in international activities.

5.2 Extensions and robustness checks

We extend this analysis in several ways. First, we look at the effect of separate international activities (foreign ownership, supplying MNEs, exporting and importing) on demand for skills. The results are reported in Table 16. The results show that foreign ownership, exporting and importing are associated with a higher share of employees with tertiary education, but the effect of participation in these activities on the share of employees with tertiary education becomes statistically insignificant when we control for firm fixed effects. Only exporting is associated with a higher share of nonproduction employees and it becomes statistically insignificant when we control for firm fixed effects. None of the international activities is associated with a higher share of skilled production employees. Supplying MNEs and importing are associated with higher likelihood of provision of formal training and of provision of training to production employees and this relationship is robust to the controlling for firm fixed effects. Only importing is associated with higher likelihood of provision of formal to nonproduction employees and this relationship is robust to the controlling for firm fixed effects. In conclusion, the results are consistent with those from the baseline specifications, but they also show that different activities have different effects on demand of skilled labour.

We repeat all the estimations for the 2005-2009 balanced panel sample. The results of these estimations are reported in Table 17. Overall, the results are similar to the results obtained for the 2002-2005 balanced panel. The main differences are that participation in international activities is not significantly related to share of employees with tertiary education and to the share of nonproduction employees and to training of production employees. Participation in international activities is positively and significantly associated with training and with training of nonproduction employees. However, similar to our results for 2002-2005 panel, the effect of participation in international activities on training becomes insignificant when we control for firm unobserved characteristics.

We also test whether the inclusion of other technology measures affects the results. In our main specification we control for the introduction of new products/upgrading of the existing ones, which is in line with the theory and also with the measures used in previous empirical studies. However, previous studies also found that other measures of technology (like ICT) or quality are associated with better skilled labour force. We estimate a variant of specification (1) which includes measures of the use of ICT technology and quality. The definitions of these variables are given in section 4. The results are reported in Table 18 and they show that our main findings remain robust to the inclusion of these technology measures. The use of internet and having an internationally recognised quality certificate are associated with a better educated labour force and a higher likelihood that the firm provides formal training to its employees (production and nonproduction employees). However, when we control for firm unobserved characteristics their effect on labour skills becomes insignificant.

We also estimate specification (1) separately for the firms in CEE countries and for the firms in CIS countries. Most of previous empirical studies the effect of international integration on

the employment of skilled labour in transition and developing countries suggest that the results might depend on country characteristics, especially the level of development and in the case of transition countries progress with the transition process. CEE countries are more advanced in their transition process, in their integration in world economy and have a higher GDP per capita (on average) than CIS countries. Due to these differences between the two groups of countries, the effect of international integration on the labour skills could also differ. The results for the estimations for the two groups of countries are reported in Table 19. We find that the results for the two groups are similar. In both groups of countries, firms that engage in international activities employ a higher share of employees with tertiary education and are more likely to provide training, but they employ a higher share of nonproduction employees only in CEE countries. In both groups of countries the effect of participation in international activities becomes insignificant when we control for firm unobserved characteristics.

6 Conclusions

In this paper we studied empirically how firms' participation in international activities affects their demand for skills and the ways in which firms meet this demand for skills in 26 transition countries. Our results suggest that firms engaged in international activities have a better educated labour force and are more likely to train their production and nonproduction employees than domestic firms. We do not find evidence that firms that engage in international activities employ higher share skilled production employees than domestic firms. However, this happens because firms with better skilled workforces and with formal training programmes select into participating in international activities, and not because these firms upgrade the skills of their workforces after starting to participate in international activities.

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Annexes

A. Sample Composition

Table 8 Sample composition by country

Sector	2002		2005		2009		2005-2009		2005-2009		2002-2009	
	Plants	%	Plants	%	Plants	%	Plants	%	Plants	%	Plants	%
Albania	170	2.76	204	2.24	54	0.56	60	5.85	12	0.77	5	1.34
Armenia	171	2.78	351	3.86	374	3.85	30	2.93	80	5.12	19	5.08
Azerbaijan	170	2.76	350	3.85	380	3.91	45	4.39	83	5.32	23	6.15
Belarus	250	4.06	325	3.57	273	2.81	33	3.22	58	3.72	13	3.48
Bosnia and Herzegovina	182	2.96	200	2.2	361	3.72			63	4.04		
Bulgaria	250	4.06	300	3.3	288	2.97	51	4.98	80	5.12	38	10.16
Croatia	187	3.04	236	2.59	104	1.07	47	4.59	36	2.31	14	3.74
Czech Republic	268	4.36	343	3.77	250	2.58	32	3.12	13	0.83	4	1.07
Estonia	170	2.76	219	2.41	273	2.81	51	4.98	48	3.07	18	4.81
FYROM	170	2.76	200	2.2	366	3.77	16	1.56	69	4.42	18	4.81
Georgia	174	2.83	200	2.2	373	3.84	38	3.71	48	3.07	20	5.35
Hungary	250	4.06	610	6.7	291	3	44	4.29	47	3.01	15	4.01
Kazakhstan	250	4.06	585	6.43	544	5.6	45	4.39	62	3.97	15	4.01
Kyrgyz Republic	173	2.81	202	2.22	235	2.42	28	2.73	59	3.78	12	3.21
Latvia	176	2.86	205	2.25	271	2.79	43	4.2	46	2.95	11	2.94
Lithuania	200	3.25	205	2.25	276	2.84	45	4.39	34	2.18	11	2.94
Moldova	174	2.83	350	3.85	363	3.74	16	1.56	112	7.17	16	4.28
Montenegro	20	0.33	18	0.2	116	1.19			5	0.32		
Poland	500	8.13	975	10.72	455	4.69	69	6.73	70	4.48	9	2.41
Romania	255	4.14	600	6.59	541	5.57	57	5.56	85	5.45	7	1.87
Russian Federation	506	8.22	601	6.61	1004	10.34	35	3.41	51	3.27	6	1.6
Serbia	230	3.74	282	3.1	388	4	26	2.54	94	6.02	17	4.55
Slovakia	170	2.76	220	2.42	275	2.83	24	2.34	28	1.79	5	1.34
Slovenia	188	3.06	223	2.45	276	2.84	53	5.17	35	2.24	22	5.88
Tajikistan	176	2.86	200	2.2	360	3.71	10	0.98	59	3.78	8	2.14
Ukraine	463	7.52	594	6.53	851	8.77	111	10.83	84	5.38	36	9.63
Uzbekistan	260	4.23	300	3.3	366	3.77	16	1.56	100	6.41	12	3.21
Total	6153	100	9098	100	9363	100	1025	100	1561	100	374	100

Source: BEEPS 2002-2009

Table 9 Sample composition by sector

Sector	2002		2005		2009		2005-2009		2005-2009		2002-2009	
	Plants	%	Plants	%	Plants	%	Plants	%	Plants	%	Plants	%
Mining and quarrying	70	1.14	93	1.02	3	0.03	15	1.46				
Construction	775	12.6	889	9.77	910	9.72	115	11.2	162	10.4	53	14.17
Manufacturing	1534	24.93	3600	39.57	3874	41.4	235	22.9	682	43.7	113	30.21
Transport, storage and communication	496	8.06	599	6.58	543	5.8	78	7.61	131	8.39	22	5.88
Wholesale and Retail Trade	1862	30.26	2184	24.01	3491	37.3	269	26.2	468	30	140	37.43
Real estate, renting and business services	641	10.42	801	8.8	137	1.46	172	16.8	5	0.32	9	2.41
Hotels and Restaurants	384	6.24	467	5.13	405	4.33	54	5.27	113	7.24	34	9.09
Other services	391	6.35	465	5.11			87	8.49			3	0.8
Total	6153	100	9098	100	9363	100	1025	100	1561	100	374	100

Source: BEEPS 2002-2009

Table 10 Sample composition by size categories

Size category	2002		2005		2009		2002-2005		2005-2009		2002-2009	
	Plants	%	Plants	%	Plants	%	Plants	%	Plants	%	Plants	%
Small (<20)	3098	50.60	4845	53.26	3719	38.31	514	50.20	789	50.58	190	50.94
Medium (20-99)	1657	27.07	2555	28.09	3449	35.53	291	28.42	455	29.17	114	30.56
Large (>99)	1367	22.33	1697	18.65	2540	26.16	219	21.39	316	20.26	69	18.50
Total	6122	100	9097	100	9708	100	1024	100	1560	100	373	100

Source: BEEPS 2002-2009

Table 11 Number of firms with information on measures of workforce skills and all the main variables

	2002	2005	2009	2002-2005	2005-2009	2002-2009
All	6153	9098	9708	1025	1561	374
Country	6153	9098	9708	1025	1561	374
Sector	6153	9098	9363	1025	1525	370
Size	6122	9097	9363	1024	1524	396
Foreign ownership	5739	9097	9253	921	1510	338
Exporting	5709	9084	9227	915	1506	336
Importing	5380	8848	3381	830	578	95
Supplying MNEs	5190	8583		777		
Education	4291	8445	3241	644	547	85
Non production workers	5125	8491	3354	759	577	95
Skilled prod workers	4488	7508	3264	597	537	90
Training	5190	8583	3366	777	577	94
Training nonproduction workers	4684	6355	3312	485	397	51
Training production workers	5080	8384	3316	739	550	89

Source: BEEPS 2002-2009

B. Descriptive Statistics

Table 12 Labour skills—summary statistics

	Education	Nonproduction Empl.	Skilled Production Empl.	Training	Training Nonprod empl.	Training prod. empl.
Cross section 2002	0.38	0.43		0.37	0.11	0.32
Cross section 2005	0.28	0.40		0.38	0.16	0.35
Cross section 2009	0.23	0.26		0.39	0.29	0.35
Panel 2002-2005						
2002	0.38	0.44		0.39	0.12	0.34
2005	0.30	0.43		0.44	0.18	0.41
Panel 2005-2009						
2005	0.24	0.34		0.44	0.20	0.40
2009	0.21	0.26		0.36	0.26	0.33

Source: BEEPS 2002-2009

Table 13 Labour force with tertiary education WDI (%)

Country	2001	2002	2004	2005	2007
Albania	8.0	7.9			
Azerbaijan					22.3
Bosnia and Herzegovina					11.0
Bulgaria	23.3	23.0	24.1	24.1	24.3
Croatia	17.2			18.2	18.1
Czech Republic	11.6	12.5	13.2	13.7	14.4
Estonia	30.7	31.5		34.2	33.7
Georgia		27.2	26.6		29.9
Hungary	16.5	18.6	20.0	20.2	20.6
Kazakhstan		47.4	50.0		
Kyrgyz Republic			16.0	2.4	
Latvia	19.9	20.3	21.3	22.3	23.6
Lithuania	46.0	45.9	27.7	29.1	32.1
Montenegro				11.7	
Poland	12.9	14.0	17.4	18.9	21.5
Romania	9.1	10.0		12.2	13.3
Russian Federation		24.8	51.5	50.4	52.5
Slovak Republic	11.5	11.5	13.4	15.2	15.1
Slovenia	16.6	17.0	19.6	20.9	
Tajikistan			10.9		
Ukraine		66.1		45.2	

Source: World Bank Development Indicators 2001, 2002, 2004, 2005, 2007.

Table 14 Labour skills and international activities (1)

	Education	Nonprod.	Skilled prod.empl.	Training	Training nonprod. empl.	Training prod. empl.
<i>Cross section 2002</i>						
Domestic	0.34	0.44	0.79	0.25	0.05	0.22
Foreign	0.47	0.47	0.80	0.44	0.17	0.36
MNE supplier	0.43	0.46	0.82	0.54	0.21	0.48
Exporter	0.37	0.41	0.80	0.49	0.18	0.44
Importer	0.39	0.43	0.81	0.43	0.14	0.38
<i>Cross section 2005</i>						
Domestic	0.24	0.39	0.83	0.26	0.08	0.24
Foreign	0.37	0.43	0.79	0.53	0.33	0.48
MNE supplier	0.33	0.43	0.82	0.53	0.31	0.49
Exporter	0.30	0.38	0.81	0.55	0.33	0.51
Importer	0.30	0.40	0.82	0.47	0.25	0.43
<i>Cross section 2009</i>						
Domestic	0.22	0.26	0.79	0.22	0.14	0.20
Foreign	0.22	0.25	0.73	0.53	0.41	0.48
Exporter	0.21	0.26	0.75	0.53	0.43	0.48
Importer	0.23	0.27	0.76	0.47	0.36	0.43

Source: BEEPS 2002-2009

Table 15 Labour skills and international activities (2)

	Education	Nonprod.	Skilled prod. empl.	Training	Training nonprod. empl.	Training prod. empl.
<i>Panel 2002-2005</i>						
<i>2002</i>						
Domestic	0.36	0.45	0.75	0.22	0.03	0.19
Foreign	0.48	0.48	0.75	0.45	0.35	0.37
MNE supplier	0.39	0.44	0.76	0.64	0.33	0.58
Exporter	0.37	0.43	0.75	0.57	0.31	0.51
Importer	0.39	0.44	0.78	0.47	0.19	0.41
<i>2005</i>						
Domestic	0.31	0.44	0.77	0.33	0.08	0.30
Foreign	0.41	0.43	0.76	0.62	0.42	0.58
MNE supplier	0.39	0.48	0.81	0.58	0.35	0.53
Exporter	0.33	0.41	0.78	0.60	0.38	0.57
Importer	0.35	0.42	0.78	0.53	0.28	0.49
<i>Panel 2005-2009</i>						
<i>2005</i>						
Domestic	0.23	0.39	0.83	0.29	0.09	0.27
Foreign	0.28	0.33	0.76	0.44	0.23	0.40
Exporter	0.22	0.31	0.79	0.57	0.32	0.52
Importer	0.24	0.32	0.81	0.53	0.27	0.48
<i>2009</i>						
Domestic	0.20	0.26	0.77	0.29	0.18	0.27
Foreign	0.21	0.27	0.70	0.47	0.37	0.45
Exporter	0.19	0.26	0.74	0.44	0.34	0.42
Importer	0.20	0.26	0.74	0.38	0.28	0.36

Source: BEEPS 2002-2009

C. Robustness checks

Table 16 Foreign ownership, supplying MNEs, exporting and importing and skills (balanced panel 2002-2005, pooled OLS and FE estimations)

	Education		Nonprod		Skilled prod		Training		Training nonprod		Training prod	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
Foreign	0.047*	0.022	0.009	-0.018	-0.025	-0.041	0.012	-0.139*	0.145***	-0.005	-0.033	-0.147*
	(0.025)	(0.035)	(0.027)	(0.046)	(0.030)	(0.053)	(0.043)	(0.082)	(0.040)	(0.082)	(0.052)	(0.088)
MNEs supplier	0.003	-0.037*	0.029	0.002	0.017	-0.001	0.119***	0.102**	0.025	-0.050	0.164***	0.149**
	(0.021)	(0.022)	(0.022)	(0.029)	(0.025)	(0.035)	(0.038)	(0.051)	(0.037)	(0.051)	(0.045)	(0.060)
Exporter	0.061***	0.015	0.083***	0.025	0.000	-0.034	0.029	0.068	0.051	0.085	0.057	0.109
	(0.021)	(0.026)	(0.022)	(0.035)	(0.025)	(0.040)	(0.034)	(0.061)	(0.035)	(0.066)	(0.041)	(0.068)
Importer	0.041**	0.005	0.007	-0.004	0.014	-0.017	0.101***	0.082**	0.096***	0.083**	0.088***	0.094*
	(0.017)	(0.018)	(0.018)	(0.023)	(0.020)	(0.028)	(0.028)	(0.040)	(0.028)	(0.042)	(0.033)	(0.048)
Innovation	0.018	-0.025	-0.006	-0.051**	-0.001	0.019	0.103***	0.054	0.063**	0.049	0.093***	-0.021
	(0.016)	(0.017)	(0.017)	(0.021)	(0.020)	(0.027)	(0.027)	(0.037)	(0.027)	(0.038)	(0.032)	(0.044)
Obs.	1288	1288	1518	1518	1194	1194	1554	1554	800	c	1168	1168
R ²	0.391	0.861	0.294	0.753	0.128	0.677	0.227	0.671	0.307	0.742	0.218	0.679

Notes: All the estimations include controls for other firm characteristics and year, country, industry and city fixed effects. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table 17 Labour skills and participation in international activities (balanced panel 2005-2009, pooled OLS and FE)

	Education		Nonprod		Skilled prod		Training		Training nonprod		Training prod	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
International	0.019	0.003	-0.022	-0.011	-0.006	-0.051	0.065*	0.074	0.061*	0.050	0.050	0.090
Activities	(0.014)	(0.021)	(0.014)	(0.024)	(0.021)	(0.034)	(0.034)	(0.055)	(0.034)	(0.053)	(0.036)	(0.058)
Innovation	0.027*	0.006	0.002	0.004	-0.014	0.033	0.168***	0.131***	0.133***	0.099**	0.167***	0.140***
	(0.014)	(0.018)	(0.014)	(0.020)	(0.020)	(0.029)	(0.033)	(0.046)	(0.033)	(0.045)	(0.035)	(0.049)
Obs.	1094	1094	1154	1154	1074	1074	1154	1154	750	750	1022	1022
R ²	0.344	0.742	0.220	0.621	0.152	0.597	0.187	0.625	0.282	0.691	0.187	0.618

Notes: All the estimations include controls for other firm characteristics and year, country, industry and city fixed effects. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table 18 Other measures of technology (balanced panel 2002-2005, pooled OLS and FE)

	Education		Nonprod		Skilled prod		Training		Training nonprod		Training prod	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
International	0.048**	0.004	0.031*	0.005	0.024	-0.015	0.093***	0.068	0.086***	0.054	0.107***	0.106**
Activities	(0.019)	(0.020)	(0.018)	(0.024)	(0.021)	(0.030)	(0.027)	(0.043)	(0.029)	(0.045)	(0.032)	(0.051)
Innovation	0.011	-0.026	-0.005	-0.049**	0.002	0.019	0.092***	0.057	0.062**	0.048	0.077**	-0.018
	(0.016)	(0.017)	(0.017)	(0.021)	(0.020)	(0.026)	(0.027)	(0.038)	(0.028)	(0.039)	(0.030)	(0.045)
Quality certificate	0.025	0.014	0.039*	0.008	-0.028	-0.008	0.120***	0.063	0.095**	-0.007	0.154***	0.110*
	(0.019)	(0.023)	(0.022)	(0.0310)	(0.026)	(0.037)	(0.036)	(0.055)	(0.040)	(0.054)	(0.040)	(0.063)
Internet	0.097***	0.035*	0.025	-0.049*	-0.004	-0.057	0.101***	0.093*	0.016	0.046	0.107***	0.091
	(0.020)	(0.020)	(0.019)	(0.026)	(0.023)	(0.035)	(0.030)	(0.048)	(0.032)	(0.045)	(0.034)	(0.055)
Obs.	1282	1282	1512	1512	1190	1190	1548	1548	794	794	1164	1164
R ²	0.404	0.861	0.288	0.755	0.130	0.680	0.234	0.668	0.287	0.739	0.228	0.675

Notes: All the estimations include controls for other firm characteristics and year, country, industry and city fixed effects. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Table 19 Differences between CIS and CEE countries (balanced panel 2002-2005, pooled OLS and FE)

	Education		Nonprod		Skilled Prod empl		Training		Training nonprod empl.		Training prod empl.	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
CEE												
International	0.060***	0.010	0.046**	0.020	0.036	-0.024	0.110***	0.090	0.093**	0.041	0.130***	0.126**
Activities	(0.020)	(0.023)	(0.020)	(0.028)	(0.023)	(0.036)	(0.034)	(0.055)	(0.042)	(0.063)	(0.039)	(0.064)
Innovation	0.005	-0.046**	-0.007	-0.047*	0.001	0.038	0.088***	0.058	0.088**	0.132**	0.072*	-0.024
	(0.019)	(0.020)	(0.020)	(0.025)	(0.022)	(0.032)	(0.033)	(0.049)	(0.041)	(0.059)	(0.038)	(0.057)
Obs.	836	836	1018	1018	826	826	1042	1042	480	480	804	804
R ²	0.370	0.857	0.263	0.757	0.180	0.666	0.196	0.631	0.318	0.753	0.189	0.644
CIS												
	Education		Nonprod		Skilled Prod empl		Training		Training nonprod empl.		Training prod empl.	
	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE
International	0.107***	0.008	0.038	-0.076	0.011	0.006	0.136***	0.046	0.122***	0.057	0.149***	0.079
Activities	(0.029)	(0.039)	(0.030)	(0.049)	(0.039)	(0.062)	(0.042)	(0.069)	(0.033)	(0.059)	(0.054)	(0.088)
Innovation	0.057**	0.019	0.004	-0.065*	-0.023	-0.022	0.163***	0.050	0.036	-0.051	0.188***	0.018
	(0.028)	(0.031)	(0.028)	(0.039)	(0.037)	(0.049)	(0.040)	(0.055)	(0.032)	(0.047)	(0.052)	(0.069)
Obs.	452	452	500	500	368	368	512	512	320	320	364	364
R ²	0.369	0.858	0.315	0.755	0.118	0.723	0.287	0.754	0.241	0.701	0.292	0.771

Notes: All the estimations include controls for other firm characteristics and year, country, industry and city fixed effects. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.