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AN INDUSTRY-LEVEL INVESTIGATION

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In 2009 all ECB publications feature a motif taken from the €200 banknote.

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Abstract

This paper presents empirical evidence of the effect of FDI inflows on productivity convergence in central and eastern Europe, using industry-level data. Four conclusions stand out. First, there is a strong convergence effect in productivity, both at the country and at the industry level. Second, FDI inflow plays an important role in accounting for productivity growth. Third, the impact of FDI on productivity critically depends on the absorptive capacity of recipient countries and industries. Fourth, there is important heterogeneity across countries, industries and time with respect to some of the main findings.

Keywords: productivity convergence, FDI, absorptive capacity

JEL classification: C23, F21, O33

Non-technical summary

The central and eastern European EU Member States have recorded impressive productivity gains over the past 15 years. Despite this catching-up process, however, a marked gap vis-à-vis the rest of the EU remains. These productivity gains have been accompanied by substantial inflows of FDI, which have been facilitated by supportive government policies. These capital inflows are generally considered to be the main vehicle for economic restructuring and technology diffusion. The empirical evidence on the link between productivity and FDI in the central and eastern European region has, however, been more mixed, probably due to a lack of cross-country and cross-industry data.

A key question is thus how important FDI inflows have been for the convergence process in general and for productivity gains in particular. If FDI has a consistent positive impact on productivity, this would imply that countries should continue to pursue policies aimed at attracting FDI. In addition, it is important to understand whether and which economic conditions affect the size of the benefits associated with FDI inflows. Studies on productivity growth have underlined the importance of absorptive capacity, and tacit knowledge in particular, which may enhance the transfer of technology and thereby strengthen the impact of FDI on productivity growth. The emphasis on absorptive capacity is based on the idea that the potentially positive impact of FDI on the receiving economy may fail to materialise if domestic companies lack sufficient abilities to imitate and adopt superior technologies used by foreign firms. This capacity to absorb technology depends on a wide range of factors, such as levels of basic technological literacy and advanced skills or on the quality of the business environment in general. Absorptive capacity can be measured in various ways, for example on the basis of human capital indicators or using the relative productivity level.

This paper provides empirical evidence of the overall effect of FDI inflows for productivity convergence in central and eastern Europe, using industry-level data from a relatively new and to a large extent still unexploited database (EU KLEMS). These data have a country, industry and time dimension, covering a wide range of countries and sectors in a consistent way. An important feature of the paper is that it also concentrates on whether the size of benefits associated with FDI depends on the absorptive capacity of the recipient country. The robustness of the empirical results in

the paper is checked by relying on two alternative econometric approaches, one exploiting the cross section while the other the time dimension of the data.

The results in this paper point to the following conclusions. First, there is a strong convergence effect in productivity both at the country and at the industry level, i.e. productivity growth depends positively on its gap vis-à-vis the euro area. At the country level, this effect is highly pronounced in the Baltic region. At the industry level, the convergence effect is particularly strong in the manufacturing sector. Second, foreign capital, in the form of FDI inflows, plays an important role in accounting for productivity growth in the central and eastern European region. Third, the impact of FDI on productivity critically depends on the capacity to absorb technology. More specifically, the effect of FDI on productivity seems to be increasing with a declining productivity differential vis-à-vis the euro area. There is also evidence that the level of human capital is positively associated with a larger impact of FDI. The former type of interaction between absorptive capacity and the beneficial impact from FDI seems to be important in manufacturing, whereas the latter is more significant in services.

Overall, using a new harmonised industry-level database, this paper provides empirical evidence that FDI and absorptive capacity are key factors for productivity convergence in central and eastern Europe. The policy implication of this result is that creating favourable conditions for FDI is likely to support productivity convergence. More importantly, however, the favourable impact of FDI on productivity is not automatic and can be strengthened by improving the absorptive capacity of the recipient economy, for example via raising the level of human capital.

1. Introduction

After more than 15 years of transition and despite an impressive catching-up process, productivity levels in central and eastern European EU countries remain substantially below those in the rest of the EU. In 2005, for example, average GDP per capita in the region stood at around 55% of the euro area (see Arratibel et al., 2007).[1] Further raising productivity levels, therefore, remains a key priority for economic policies in these countries. Understanding developments in productivity is also crucial for the analysis of short-term dynamics of GDP growth and for imbalances between supply and demand, as productivity is a key determinant of the supply side of the economy.

The catching-up process in central and eastern Europe has coincided with large inflows of foreign direct investment (FDI). A key question arising from this phenomenon is how important FDI inflows have been for the convergence process in general and for productivity gains in particular. If FDI has a consistent positive impact on productivity, this would imply that countries should continue to pursue policies aimed at attracting FDI. In addition, it is important to understand whether and which economic conditions affect the size of the benefits associated with FDI inflows.

The existing cross-country studies on growth and productivity in central and eastern Europe largely have a stocktaking or growth-accounting character and concentrate mostly on the macro-level (see e.g. Campos and Coricelli, 2002; Doyle et al., 2001; European Commission, 2004; Lenain and Rawdanowicz, 2004). The main focus of this literature is on the pace and nature of the growth process, concentrating on the period since the start of the transition to a market economy. These studies mostly underline the importance of economic policies (including institutions) for growth and convergence.

There have been a number of attempts to investigate the link between FDI and economic growth in a more formal way. Only very few of them, however, take a cross-country or cross-industry perspective, mainly due to the lack of comparable data. For instance, Holland and Pain (1998) examine the early stages of transition in central and eastern Europe (1992-1996). They estimate a labour demand function using aggregate data for eight countries and find that the stock of inward foreign

[1] Weighted average of the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia. In this paper, central and eastern Europe refers to these eight EU countries.

investment has a positive impact on productivity, with the beneficial effects being higher in the more market-orientated economies. These results were broadly confirmed by a related study of Barrell and Holland (2000), based on industry-level data covering eleven manufacturing sectors in the Czech Republic, Hungary and Poland.

Other empirical evidence on the role of FDI in the catching-up process of transition economies has been less conclusive. For example, Mencinger (2003) applies a Granger causality test to aggregate data covering eight central and eastern European economies in the period 1994-2001. The main finding is that the relationship between FDI and GDP growth is negative, which is attributed to the character of FDI during this period (mostly privatisation-related rather than greenfield investment). Hunya (1997) estimates that foreign-owned enterprises operating in the region have on average higher labour productivity than domestic firms, but notes that this may be related to the concentration of the former in more capital intensive industries. This hypothesis was confirmed by Djankov and Hoekman (2000), who use firm-level data from the Czech Republic and conclude that, after controlling for various kinds of selection biases, FDI does not seem to have a significant effect on productivity growth.

Following an improved availability of firm-level data, an increasing number of papers on the link between FDI and growth have focused on productivity spillovers from foreign-owned companies to other firms in the economy.[2] A key conclusion emanating from these studies is that spillovers vary by country, sector and type of firm, depending also on the nature of FDI and absorptive capacity of domestic enterprises.

The approach taken by the most recent spillover literature has many advantages over the earlier studies. While it is certainly of interest whether there are any externalities associated with FDI inflows, an important question remains about their total impact on aggregate productivity. More specifically, since multinational companies are among the most technologically advanced firms, their presence may be beneficial for a recipient country even if their superior knowledge does not spill over

[2] See a meta-analysis by Görg and Greenaway (2004) or an investigation in a cross-country setup by Damijan et al. (2003). More recent contributions to the spillover literature focusing on central and eastern Europe include Gersl et al. (2007), Gorodnichenko et al. (2007) and Kolasa (2008).

to domestic firms. Therefore, it may still be useful to take a less disaggregated perspective for assessing the macroeconomic impact of FDI.

A relatively detailed industry-level analysis has recently become possible thanks to the EU KLEMS database. It covers a wide range of sectors in an internationally comparable way and can be considered as a state-of-the-art source for cross-country and cross-industry comparisons. With this relatively new and to a large extent still unexploited database, we can carry out an econometric analysis, using data with both a country, industry and time dimension. To the best of our knowledge, this has not been done for transition economies before.

There are two other important features of our paper that distinguish it from the previous literature. First, we investigate formally how the size of overall benefits associated with FDI depends on the absorptive capacity of the recipient country, which allows us to shed more light on the cross-country variation in the estimated effects of FDI found in previous studies. Second, in the empirical part we employ two alternative econometric approaches, differing in the extent to which they exploit the industry versus the time dimension of the data. This makes our main conclusions more robust compared to earlier studies, relying only on one single method.

The rest of the paper is structured as follows. Section 2 provides stylized facts on the catching-up process and foreign capital inflow to central and eastern Europe. In Section 3, we discuss some theoretical considerations underlying our empirical investigation. Section 4 presents the econometric strategy. Section 5 describes data sources and definitions of variables. The main results and robustness checks are discussed in Section 6. Section 7 concludes.

2. Stylized facts on productivity convergence and FDI inflows in central and eastern Europe

Despite impressive increases over the past 15 years, labour productivity levels in central and eastern Europe remain well below those in the rest of the EU. Taking the euro area as a benchmark, Charts 1 and 2 provide an overview of relative labour productivity (calculated as value added per hour worked, see Section 5 for more details).[3]

Chart 1 shows that there is substantial heterogeneity in productivity levels across sectors. Whereas productivity gaps vis-à-vis the euro area in the mid-1990s were relatively large in industry, they were substantially less pronounced in construction and market services. In particular, output per hour in financial and business-related services was relatively close to that in the euro area already in the mid-1990s. Despite marked increases over the past decade, labour productivity levels in almost all sectors remain consistently lower than in the euro area. This applies particularly to industry, where output per hour was on average only around one third of the euro area in 2006. In services, productivity levels were on average around half of those in the euro area, whereas in construction the pattern was quite diverse across countries.

[Chart 1 and 2 about here]

Focusing on the dynamics since 1995, Chart 2 shows that cumulative productivity gains in industry since the mid-1990s have outpaced those in the other sectors. Whereas there seems to be a strong convergence effect present in industry, such a pattern was less clearly visible in construction and services. Within the service sector, however, the patterns are not homogenous. In the more traditional services, most countries in the group managed to raise productivity significantly, with cumulative gains between 1995 and 2006 mostly ranging from 20% to 70% (apart from Estonia, where productivity increases were much higher, see the charts in the Annex for a country-by-country overview). In the financial and business-related services, by contrast, productivity gains remained more limited, particularly in the central European countries (the Czech Republic, Hungary, Poland, Slovakia and

[3] For presentational reasons, the individual industries for which data are available have been lumped together in this section into four broadly defined sectors. Industry, in the first panel, mainly consists of manufacturing, together with mining and quarrying and electricity, water and gas supply (NACE categories D, C and E, respectively). The second sector is construction (NACE F). The third and fourth sectors are (market) services, with the former covering the more “traditional” services, such as trade and repairs, hotels and restaurants as well as transport and communication (NACE G, H and I), while the latter comprises financial and business-related services (NACE J and K). These four sectors together cover all economic activities except agriculture (and related branches) and non-market services.

Slovenia). The industrial sector thus seems to be the main driver of labour productivity convergence vis-à-vis the euro area. This productivity pattern across sectors seems intuitive, given the differences in capital intensity and technology content between these broadly defined sectors.

A similar convergence effect seems to be present at the macro-level across the countries considered, as the economies with the lowest initial productivity levels have been catching up relatively rapidly. This applies in particular to the Baltic countries (Estonia, Latvia and Lithuania), where labour productivity levels increased from around a quarter of those in the euro area in the mid-1990s to around 30-40% in 2006. In the central European countries, where output per hour was on average around 40% of the euro area level in 1995, productivity rose to around 50% of the euro area in 2006.

Productivity convergence in central and eastern Europe has often been associated with FDI inflows, which are considered to be the main vehicle for economic restructuring and technology diffusion (see, for example, EBRD, 1994 or Damijan and Rojec, 2007). Central and eastern European countries have been quite successful in attracting FDI, also relative to other emerging market economies (see Castejón and Wörz, 2006). Annual changes in FDI stocks have averaged around 5% of GDP in the eight central and eastern European countries considered in this paper, though there were large fluctuations from year to year. Looking at the allocation of FDI across countries, Chart 3 shows that Estonia stood out in receiving the largest inflows, with the FDI stock increasing from around a quarter to almost 100% of GDP between 1997 and 2005. The Czech Republic and Hungary also recorded sizeable cumulated inflows and the FDI stock to GDP ratio was slightly above 50% in both economies in 2005. Overall, there does not seem to be a clear geographical pattern in FDI inflows.

[Chart 3 about here]

As regards the allocation of FDI across sectors, most inflows have gone to financial and business-related services and industry. Chart 4 shows that in these sectors FDI stocks relative to value added increased substantially over the past decade. The country-by-country charts in the Annex show that the high FDI intensity in Estonia, the Czech Republic and Hungary seems to be broad-based, with these countries consistently having the highest FDI to value added ratios in industry and in both broadly defined service sectors.

At a more disaggregated level, by far the largest recipient of FDI in services was financial intermediation, followed by business-related services (i.e. real estate, renting and business activities) and trade. The FDI stock to value added ratio in the transport, storage and communication also increased very strongly, but reached a peak already around the turn of the century (whereas the FDI intensity in financial and business-related services exhibits a consistent upward trend). Although initially FDI in services seems to have been associated with privatisation, other motives like market seeking, cost reduction and (more recently) outsourcing seem to have been important driving factors as well (Gersl et al., 2007). Within industry, FDI inflows were concentrated in transport equipment, food, as well as electrical and optical equipment. FDI in industry seems to have been mainly motivated by cost reduction, although privation also played a role in the earlier FDI inflows.

[Chart 4 about here]

To conclude, this overview of the data can be summarised by three observations. First, the initial level of productivity matters for the subsequent speed of convergence towards the euro area. At the sectoral level, this convergence effect is illustrated by the relatively strong productivity increases in industry over the past decade following relatively low levels in the mid-1990s. At the macro-level, the relatively strong increases in output per hour in the Baltic States, which had relatively low productivity levels in the mid-1990s, point into the same direction. Second, FDI inflows have mostly been concentrated in financial and business-related services and, to a lesser extent, in industry, although FDI patterns have been rather diverse across sectors and countries. At the country level, Estonia, the Czech Republic and Hungary have been the main FDI recipients over the past decade relative to their economic size. Finally, considerable differences exist across countries and sectors both as regards productivity developments and FDI inflows, particularly at a more disaggregated level.

3. Theoretical considerations

While FDI is definitely not the only channel through which international technological diffusion may occur, it is widely considered to be the most important one. This is because multinational corporations are among the most technologically advanced firms, spending relatively big amounts on research and development and using better managerial practices. This implies that inward FDI may involve the transfer of superior technologies, which can then spread over the entire economy leading to productivity gains in domestic firms (see e.g. Findlay, 1978 or Romer, 1993).[4]

The link between inward FDI and economic growth in developing countries has firm theoretical foundations. As demonstrated by Borensztein et al. (1998), this relationship can be derived using the framework of international technology diffusion developed by Barro and Sala-i-Martin (1997) and drawing on seminal contributions to the theory of endogenous growth by Romer (1990) or Grossman and Helpman (1991).

According to this setup, per-capita (or labour productivity) growth occurs via accumulation of human capital and the expansion in the number of varieties of capital goods used in production of final goods. These varieties are produced by domestic and foreign firms that have undertaken a direct investment in the economy. An increase in the number of capital varieties requires a fixed cost of adapting the technology available in more advanced economies. This cost decreases with the share of foreign firms operating in the host economy and is negatively related to the technological gap vis-à-vis developed countries, which reflects decreasing imitation possibilities over the catching-up process.

Similar ideas can also be incorporated into neoclassical growth models. This was done e.g. by Wang (1990), who assumes that the increase in effective knowledge applied to production can be written as a function of FDI. A description of technology diffusion involving decreasing imitation possibilities during the convergence process with an important role of human capital is owed to Nelson and Phelps (1966). Duczynski (2003) incorporates the concept of international technology diffusion into a Ramsey framework with capital mobility and discusses the implications of his model in the context of transition economies.

[4] In transition economies FDI inflows may also play an important role in the process of restructuring of formerly state-owned companies (see e.g. Blanchard, 1997).

On the basis of these theoretical considerations, one can write a simple model of productivity growth in a catching-up economy using inward FDI, the relative productivity level vis-à-vis developed economies and human capital as the main explanatory variables. The precise specification of the model can take different forms (see Section 4).

However, while FDI is generally considered to be a key channel for economic restructuring and international technology diffusion, FDI inflows as such may not necessarily be sufficient to ensure an increase in productivity. The extent to which these flows are translated into technological progress and productivity growth depends on the absorptive capacity of the sector and the country. This, in turn, hinges on the levels of basic technological literacy as well as on more advanced skills in the host country or sector (see e.g. World Bank, 2008).

The absorptive capacity concept can be implemented empirically by extending the simple model sketched out above to include interactions between the main explanatory variables. For instance, by interacting FDI with the relative productivity level we can examine to what extent gains from foreign capital inflows depend on the absorptive capacity, measured as the distance to the technological frontier. In particular, we could test the hypothesis of e.g. Glass and Saggi (1998),[5] according to which a larger development gap implies a lower quality of technology transferred via FDI and more limited capabilities of domestic firms to benefit from potential spillovers of foreign presence (implying a negative coefficient of the interaction term). On the other hand, a positive estimate would be consistent with an alternative hypothesis provided by Findlay (1978), who emphasises the larger pool of available technological opportunities and a stronger pressure for change in relatively backward economies.

Absorptive capacity considerations can also be taken into account by interacting human capital with both the relative productivity level (used as a proxy for potential technology transfer) and FDI inflow. A classical reference stressing the role of human capital in technological diffusion is Nelson and Phelps (1966), who interact measures of human capital quality with the productivity gap vis-à-vis the technological frontier in their growth regressions.[6] Borensztein et al. (1998) and

[5] See also Kokko (1994).
[6] See also Benhabib and Spiegel (2005). A confirmation of the Nelson-Phelps hypothesis, using a panel of OECD countries, can be found in Griffith et al. (2004).

Balasubramanyan et al. (1999) confirm the link between the impact of FDI and the quality of human capital.

It has to be noted that human capital and relative productivity are not the only proxies for absorptive capacity advocated in the literature. In particular, local firms' capabilities to absorb knowledge from abroad can be dependent on their own innovation effort (see Cohen and Levinthal, 1989). Also, a wide set of other characteristics (like competitive pressure, financial market development, regulations) can affect the speed of the catching-up process and the size of potential spillovers from FDI.

4. Econometric strategy

Having defined a set of potential explanatory variables, the choice of an appropriate econometric strategy is far from straightforward. In general, the most popular approaches followed in the empirical growth literature can be classified into two groups, which we will refer to as cross section and time series studies.

The first group comprises a vast literature exploiting mainly cross-country or (less frequently) cross-industry correlation between growth and a wide set of explanatory variables. The variables used in regressions are averaged over relatively long time spans covering the whole sample (e.g. Barro, 1991; Mankiw, Romer and Weil, 1992) or form a set of non-overlapping averages (e.g. Borensztein et al., 1998; Schadler et al., 2006).

The main advantage of cross section studies is that their results are less likely to be driven by cyclical movements. Moreover, by exploiting cross sectional information, they are potentially better suited for addressing questions about the sources of differences in performance across countries or industries. In practice, however, the latter advantage may be undermined by the omitted variables problem and endogeneity, leading to potentially serious biases in the estimates of the coefficients of interest.[7]

[7] In principle, this kind of problems can be mitigated by using instrumental variable techniques. However, lack of good instruments makes this option rather impractical or can even do more harm than good (see Nelson and Startz, 1990 or Bound et al., 1995).

The second group of approaches, time series studies, aims at testing relationships of interest within rather than across countries or industries. This type of approach relies mainly on yearly observations and uses panel-data methods (see e.g. Islam, 1995; Griffith et al., 2004; Carkovic and Levine, 2005).

The biggest advantage of the time series approach is that it is less vulnerable to the sources of biases that may affect purely cross section regressions. This is because the inclusion of fixed effects in the panel helps to control for unobservable heterogeneity between objects considered, making the omitted bias problem less severe. Additionally, more sophisticated panel data techniques that rely on generalized method of moments (GMM) attempt to address the endogeneity issue, although in a rather mechanistic fashion. The major weakness of the time series approach is, however, that it does not exploit cross-section variation in the data and that it may not fully account for medium and long-run relationships by using data of relatively high frequency. Although there seems to be a tendency in the empirical growth literature towards using the time series approach, one has to bear in mind that it has its flaws.

Therefore, as a matter of robustness, it might be useful to check whether the results obtained using the other approach are at least qualitatively similar. Any striking discrepancy between the time series and cross section evidence would then call for caution in interpreting the results. Given the above considerations, our empirical investigation will rely on both approaches, the details of which are summarized below.

In the time series approach, we employ the system GMM estimation framework developed by Arellano and Bond (1991) and then extended by Arellano and Bover (1995) and Blundell and Bond (1998).[8] More specifically, we regress the annual growth rate in labour productivity on the set of explanatory variables lagged one period, with a full set of time dummies.

The use of the system GMM method is motivated by the fact that our specification can be rewritten so that the level of productivity in central and eastern European Member States is expressed as a function of its own lag and the lagged level of productivity in the euro area. The presence of the lagged dependent variable implies that standard methods used for estimating panel data models, like the fixed

[8] We use the xtabond2 procedure for Stata. See Roodman (2006).

effects estimator, produce biased results if the number of time periods in the sample is small (see Nickell, 1981). Lagging other explanatory variables, and FDI in particular, is aimed at avoiding a simultaneity bias,[9] while including time dummies is expected to capture possible cyclical movements between productivity growth and right hand side variables, common across countries and industries.

The cross section approach is pursued by splitting the sample into two five-year periods and applying the SUR technique to a system of two equations.[10] All variables in these equations are expressed as five-year averages, except for the relative productivity level, which is measured in the year preceding the beginning of the relevant period. It has to be noted that our sample is different from standard cross section studies in that it has both a country and an industry dimension, which makes it possible to do the estimations with a full set of country and industry dummies. Naturally, this is not equivalent to fully controlling for unobservable heterogeneity across objects (like in the time series approach with a full set of country-industry specific effects). However, it is reasonable to expect that this strategy will at least attenuate the possible bias afflicting traditional cross section estimations. An additional advantage of including country dummies is the fact that they can be regarded as (imperfect) substitutes for country-wide indicators usually used in the empirical growth literature (quality of institutions, size of the government, macroeconomic stability, financial market development etc.).

5. Data sources and definitions of variables

The main data source of which this paper makes use is the new EU KLEMS database. It is the result of a project carried out by a consortium of research institutes and financed by the European Commission in order to facilitate productivity analyses in the EU at the industry level (see Timmer et al., 2007).[11] The main adjustments to the

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[9] We treat all lagged explanatory variables as predetermined, which means that they are assumed to be uncorrelated with present and future errors. This assumption might be violated e.g. if FDI inflow is motivated by expectations of future shocks, which seems rather unlikely.

[10] This means that our cross section approach also exploits some time series variation in the data, although to a much lesser extent than the system GMM technique applied to yearly data.

[11] EU KLEMS stands for EU analysis of capital (K), labour (L), energy (E), materials (M) and service (S) inputs. The database is downloadable at www.euklems.net. It consists of two types of variables: analytical (growth accounting) variables, such as labour and capital input, total factor productivity etc.,

official statistical sources made in the database relate to filling gaps in industry-level data (using industry statistics) and to linking series over time.[12]

A key advantage of the EU KLEMS database is that it covers a wide range of industries (up to 72 per country, including a breakdown of services) in an internationally comparable way, with the key variables anchored in official statistics. The database covers the EU Member States in central and eastern Europe from 1995 onwards. In addition, it includes a large number of variables that are potentially relevant for understanding productivity developments. These features make the database probably the state-of-the-art source for cross-country and cross-industry comparisons.

Despite the above advantages, it should be emphasised that the EU KLEMS database is still work in progress. The level of detail varies across countries, industries and variables, with some gaps in particular for the EU Member States in central and eastern Europe (see Table 1). In addition, the quality of the data is still being evaluated by the national statistical institutes of the countries concerned. More generally, it needs to be kept in mind that the measurement of productivity in services is surrounded by a number of conceptual and empirical caveats, which suggests that the data for these industries should be used with some degree of caution (this applies, however, not only to the EU KLEMS database).

Another data source used in the paper is the WIIW database on Foreign Direct Investment in Central, East and Southeast Europe (see Hunya and Schwarzhappel, 2007). It contains industry-level FDI data as reported by the national central banks of the countries in the region. A key advantage of the database is that the industry breakdown is consistent with the one in the EU KLEMS database. In addition, the data are harmonised in the sense that they are in line with standard IMF definitions and methodological guidelines (although some methodological changes over time have taken place). The FDI data in this paper come from the May 2007 release of the WIIW database.

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and statistical variables, which are largely based on national accounts (ESA95) data of the individual countries. This paper only makes use of the latter group of EU KLEMS data as the coverage of the former for the EU Member States in central and eastern Europe is still insufficient for the purposes of this study. See also Koszerek at al. (2007) for an extensive overview of the database.

[12] These adjustments were done by the EU KLEMS consortium on the basis of agreed procedures to ensure harmonisation of the data and to generate growth accounts in a consistent and uniform way. Harmonisation focused, among others, on industrial classifications, aggregation levels, reference years for volume measures, price concepts and methods for solving breaks.

[Table 1 about here]

Table 1 provides an overview of the variables used in this study. Our total sample covers nineteen sectors of eight central and eastern European EU Member States and spans the period 1995-2005. The countries considered are: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.[13] The sectors covered are: manufacturing (13 industries: NACE DA to DN, without DC), construction (NACE F) and market services (5 industries: NACE G to K).[14]

We measure labour productivity (*LP*) as real value added per hour worked.[15] Relative productivity levels (*RLP*) are calculated vis-à-vis the euro area using industry-specific purchasing power parities (PPPs) for 1997. Relative levels for the remaining years are extrapolated using labour productivity growth rates. The data are taken from the March 2007 release of the EU KLEMS database, covering the period 1995-2004.[16]

Our *FDI* variable is defined as the ratio of FDI inflow to gross value added. FDI inflow is calculated as a change in inward FDI stocks.[17] The time span covered in the WIIW database differs across countries and (to lesser extent) across industries. Most FDI data for Latvia, Lithuania and Slovenia cover the whole period of interest (1995-2005), while one or two first years are missing for the other countries.

Human capital (*HC*) is measured as the share of hours worked by high-skilled persons in total hours worked. The share of high-skilled workers is available for all but the three Baltic countries. These data were taken from the EU KLEMS database.

In addition to these main variables, there are several other indicators which we use in the empirical part of the paper. The investment rate (*INV*) is measured as gross

[13] Bulgaria and Romania are not covered in the EU KLEMS database.
[14] While data on mining and quarrying (NACE C), electricity, gas and water supply (NACE E) and manufacture of leather and leather products (DC) are generally available, these sections are excluded from our sample. The reason for doing so is their high regulation (C and E) or very small share in total economy's output (DC). It has to be noted that adding these industries to our sample keeps the main results qualitatively unchanged (see Table A1 in the Annex).
[15] Ideally, we would want to measure productivity as total factor productivity. Unfortunately, this and related measures are not available (or are hard to estimate in a consistent way) for the group of countries we focus on, particularly at this level of disaggregation.
[16] Whenever possible, data on labour productivity and nominal value added are extrapolated to 2005 using official Eurostat sources.
[17] This means that our measure of FDI inflow captures not only flow of funds, but also the revaluation effect. Unfortunately, the availability of direct data on FDI inflows is very limited, so relying on them would dramatically truncate our sample.

fixed capital formation divided by gross value added. By including the investment rate we can see whether FDI has an impact on productivity in addition to total investment. Data on gross fixed capital formation come from the Eurostat NewCronos database and are not available for Estonia, while those for Latvia and Slovenia cover only the most recent years (2003-2005 and 2000-2005, respectively).

Import penetration (*IMP*) is imports from EU-15 countries, scaled by value added. We treat this indicator as a proxy for competitive pressure. We use imports from EU-15 countries as this seems a better approximation to international competitive pressure than total imports. The data were taken from the WIIW Industrial Database Eastern Europe and are available only for manufacturing industries.

R&D intensity (*RD*) is defined as business research and development expenditures over gross value added. We include R&D expenditure as a proxy for innovation. Data on business R&D expenditure come from Eurostat and have a relatively wide industry-coverage only for the Czech Republic, Hungary and Poland.

Finally, we also use data on capacity utilisation from opinion surveys in order to capture cyclical swings in productivity. These survey data come from the European Commission's regular harmonised survey of the business sector in EU countries (see European Commission, 2007) and are available only for total manufacturing.

6. Results

6.1. Preliminary regressions

In order to establish a benchmark for our econometric choices described in Section 4, we first estimate a set of simple regressions, using only the productivity gap and FDI intensity as explanatory variables. In the case of the time series approach, we start off with simple ordinary least squares (OLS), then use the fixed effect estimator (FE) and finally run our preferred system GMM. The estimated econometric specification can be written as:[18]

$$\Delta \ln LP_{ijt} = \alpha_{ij} + \alpha_t + \beta \ln RLP_{ijt-1} + \gamma FDI_{ijt-1}$$

[18] In the OLS specification the first intercept is identical across all observations.

where subscripts i, j and t index industry, country and year, respectively, and the variables appearing in the equation are as defined in Section 5.

In the cross section approach we first run a simple OLS as a benchmark and then use our preferred SUR technique, using the following specification:[19]

$$\Delta \ln LP_{ijt} = \alpha_{it} + \alpha_{jt} + \beta \ln RLP_{ijt} + \gamma FDI_{ijt}$$

where subscript t denotes one of the two five-year subperiods. As discussed in Section 4, each SUR regression is a system of two equations, covering two five-year periods: 1996-2000 and 2001-2005.

[Table 2 about here]

The results of the preliminary regressions are reported in Table 2. As can be seen from comparing the estimates from columns 1 to 3, using OLS or FE in a dynamic panel data setup results in well-know biases of the autoregressive term. The direction of the bias is exactly as expected (see e.g. Bond, 2002): OLS clearly overpredicts the inertia in the dependent variable (and thus underpredicts the speed of convergence), while the opposite holds for the FE estimator. Comparing the results reported in columns 4 and 5 shows that adding country and industry dummies in a cross-section setup slightly changes the estimates. In particular, the coefficient of the gap term is now closer to that obtained using the time series approach.

Finally, we note that although all regressions yield significant estimates of the parameters of interest, our preferred techniques yield somewhat more conservative results in statistical terms, which is reassuring as regards the robustness of the conclusions we draw.

6.2. FDI and absorptive capacity

We start presenting our main results with a discussion of the regressions estimated using the system GMM method. The main results are reported in Table 3.

[Table 3 about here]

[19] In the OLS version there is only one intercept, common across all observations of a given 5-year subperiod.

In column 1, we repeat for convenience the estimates of the simple specification considered in the previous subsection. Both the relative productivity level and the FDI share enter in a statistically significant way, pointing to a strong convergence effect and an important role of foreign capital in accounting for productivity growth in central and eastern Europe. Compared to other studies for developing countries, our estimate of the speed of convergence looks relatively high, which should not be surprising given the close integration of the central and eastern European region with the euro area. As regards the size of the coefficient on the FDI variable, those studies finding it significant usually report higher values. On the other hand, there are a number of papers that do not find any robust relationship between FDI and growth. Our estimate is both statistically and economically significant, since it implies a long-run semi-elasticity of productivity level with respect to the FDI share of about 0.9.[20]

In column 2, we check whether FDI has effects over and above those of total investment by including investment rate as an additional explanatory variable. This may also be justified by the fact that our measure of productivity is labour productivity rather than total factor productivity. Hence, there may be some role of capital deepening in accounting for productivity developments. However, the results hardly change compared to those reported in column 1. Since including the investment rate leads to a sizable decrease in the number of observations effectively used (see Section 5), we run the remaining regressions without this control.

We next examine the effect of adding an interaction between FDI and the relative productivity level. As can be seen from column 3, we find a positive and significant coefficient, which is consistent with the absorptive capacity argument of Glass and Saggi (1998). Together with the coefficient on *FDI* without interaction becoming insignificant, this may suggest that inflow of foreign capital positively affects productivity only if the distance to the technological frontier is not too large.

In column 4, we augment the specification from column 1 by including the proxy for human capital. It turns out insignificant and does not change the remaining estimates in qualitative terms, while implying a slightly lower speed of convergence and a somewhat larger long-run effect of FDI.

[20] This becomes apparent once one realises that our specification can be viewed as a special case of an error-correction model.

The results reported in column 5 are obtained by adding the interaction between human capital and FDI. It turns out positive and significant, which reinforces the role of absorptive capacity in determining the impact of FDI on productivity growth and is consistent with the findings of Borensztein et al. (1998) obtained on a larger sample of developing countries.

In column 6 we replace the interaction of human capital and FDI with that of human capital and relative productivity. It does not enter in a significant way and does not lead to sizable changes in the coefficients on FDI or the relative productivity level compared to the regression reported in column 1.

Finally, in column 7 we show the results for a specification including all regressors. Unfortunately, such a specification suffers from serious econometric problems. More specifically, in the GMM estimation the number of instruments turns out too large relative to the number of observations, so the results cannot be treated as fully reliable.[21] Nevertheless, the estimates obtained from this extended specification seem to confirm in qualitative terms all our major results discussed so far.

We repeat the six baseline steps described above using the cross section approach and employing the SUR estimation technique. The results are shown in Table 4.

[Table 4 about here]

Except for the last specification, we get a qualitatively similar picture to that of the time series approach. In particular, we find a strong convergence effect and impact of FDI inflow, the latter exhibiting patterns suggesting an important role of absorptive capacity.

An important difference emerges from comparing column 6 of Table 3 and Table 4. Using the cross section approach we find a negative and statistically significant coefficient on the interaction between human capital and the relative productivity level, while the relative productivity term becomes insignificant. This result can be interpreted as evidence for the critical role of human capital in bridging the productivity gap in central and eastern Europe, in line with the idea advocated by

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[21] In principle, one could try to alleviate this problem by truncating the number of lags in the GMM-style instruments. Unfortunately, this is not an attractive option as tests of overidentifying restrictions and second order autocorrelation clearly reject such a simplified specification.

Nelson and Phelps (1966). However, lack of support for this finding from the time series approach suggests caution in interpreting the results this way.

6.3. The role of openness and innovation

We also estimate a set of regressions using import penetration (*IMP*) and R&D intensity (*RD*), following the same strategy as with human capital, i.e. including them alone and in interaction terms. Generally, the results are inconclusive, so we summarize them only briefly below.[22]

In the system GMM regressions, import penetration alone does not enter in a statistically significant way, while its two interactions do: the one with FDI is significantly positive, while that with relative productivity is strongly negative. This might suggest that stronger competition from abroad is conducive to larger gains from foreign capital inflows and speeds up the pace of convergence at early stages of the catch-up process. However, these findings are not confirmed using the SUR technique: the interaction of import penetration with FDI has the negative sign while that with the relative productivity level is not significant. If included in the regression without interactions, import penetration turns out highly positive. All in all, although there is some evidence for the positive role of high competition in accounting for productivity growth in the countries considered in this paper, its particular channels seem rather unclear.

All regressions including R&D intensity yield insignificant coefficients on this variable and its interaction, both in the time series and the cross section approach. It has to be emphasised, however, that the coverage of the data we have on R&D is far from satisfactory.

Including R&D intensity leaves other coefficients of interest qualitatively unchanged, while the effect of adding import penetration is very similar to that of restricting the sample to manufacturing industries (see Table 5, described in the next subsection). This is not surprising as we do not have data on imports of services.

6.4. Cross-section heterogeneity

The size of our sample, although quite impressive given well known problems with data availability and comparability across transition economies, does not allow

[22] Detailed results are available from the authors upon request.

us to examine cross section heterogeneity of parameters of interest using too detailed breakdowns. Still, it is feasible and potentially interesting to check how our results differ across sufficiently broadly defined groups of sectors or countries.

We do this type of exercise using only the system GMM approach for several specifications, which we consider as the key ones for the conclusions we have drawn so far. This is motivated by the fact that running SUR regressions even on two sub-samples of equal size in a comparable setup to that used for the total sample, i.e. with a full set of country and industry dummies, makes the number of estimated parameters too large given the standard rule-of-thumb used in applied econometric works. Therefore, to be on the safe side, we do this exercise only for those system GMM regressions which yield qualitatively similar results to the SUR approach.

First, we examine heterogeneity in the key parameters between two groups of industries: manufacturing and services (including construction). We focus on three preferred specifications, corresponding to regressions 1, 3 and 5 in Table 3. The results are reported in Table 5.

[Table 5 about here]

Three important features stand out. One is that convergence towards euro area levels is much more pronounced in manufacturing than in services, which corroborates observations made in Section 2. Second, it is manufacturing where absorptive capacity measured as the relative productivity level is important for the positive effect of FDI inflow to materialise. Third and symmetrically, the beneficial role of FDI in services highly depends on a sufficient level of human capital.

In the second breakdown, we split our sample into two regions: Central Europe (the Czech Republic, Hungary, Poland, Slovakia and Slovenia) and the Baltic countries (Estonia, Latvia and Lithuania). Also, as documented in Section 2, the Baltic countries had relatively low initial productivity levels and embarked on the transition process towards the market economy later than the five central European countries. Since we do not have data on our proxy for human capital for any of the Baltic countries, we restrict our attention to regressions 1 and 3 from Table 3. The results are reported in Table 6.

[Table 6 about here]

It is apparent that the speed of convergence is substantially faster in the Baltic region than in the central European countries. Interestingly, in the former group, the extent of the benefits from FDI seems to depend positively on the absorptive capacity, measured as the relative productivity level vis-à-vis the euro area, while the opposite holds true for the latter countries. Putting it differently, a smaller distance to the technological frontier is accompanied by a larger positive effect from FDI in the Baltic countries, whereas in central Europe inflows of foreign capital led to particularly strong productivity gains at relatively early stages of the catching-up process. A possible explanation of this finding is that the Baltic countries had too low productivity levels in the first years of our sample to extract benefits from FDI inflows and they developed this capability only gradually.[23]

6.5. Two periods of convergence

Given our findings, indicating a significant role for absorptive capacity in the convergence process, it may be interesting to examine how the relative importance of productivity determinants evolved over time. Such an exercise may be particularly useful for assessing future convergence prospects in the central and eastern European EU Member States.

Given our sample size, splitting it into two equal sub-periods makes the system GMM method rather inefficient. Therefore, this time we rely on the SUR technique and account for parameter heterogeneity over time by relaxing the restrictions on parameter equality across the equations run for the two sub-periods (1995-2000 and 2001-2005). As before, we restrict our attention to three key specifications. The results are reported in Table 7.

[Table 7 about here]

The specification including the interaction between FDI and the relative productivity level shows the most striking differences across the two sub-periods. This term is highly positive and significant in the equation estimated over the period

[23] This hypothesis seems to be confirmed by the unrestricted variant of our SUR estimations: if we allow the coefficients in regression 3 from Table 4 to vary across the two sub-periods, we get a positive and significant estimate of the interaction term only in the first equation, covering the period 1995-2000 (see Table 7).

1995-2000, while insignificant in the second half of our sample. This suggests that productivity gains of foreign capital inflows were limited by a large technological gap at the early stages of convergence, while over time this constraint ceased to play a significant role. An important implication of these results, confirmed by those obtained from a simple specification excluding the interaction, is that FDI inflows were a main driver of productivity gains in the more advanced stages of the convergence process in the central and eastern European Member States (i.e. during the second half of our sample).

On the contrary, the interaction between FDI and human capital turns out to be significant in both sub-periods. This confirms that human capital is an important factor shaping the future path of convergence in the region.

6.6. Some robustness checks

As already mentioned before, one of the weaknesses of the time series approach is that its results may be driven by cyclical rather than medium- or long-term movements. There are certainly grounds to assume that the observed procyclicality of labour productivity is to some extent due to imperfect measurement of changes in utilisation of factor inputs (see Basu and Kimball, 1997). In our case, this problem should not be very serious, since we measure labour productivity as output per hour worked rather than per person employed, hence changes in working time are explicitly taken into account. Still, it is plausible that effort per hour is not constant over the business cycle, which means that our measure of productivity may exhibit some cyclical patterns related to imperfect measurement of effective labour input.

To deal with this issue we re-estimate all regressions from Table 3 with log changes in capacity utilisation in manufacturing as a control variable.[24] This does not affect any of the main results obtained from the baseline specification (see Table A2 in the Annex). It has to be noted, however, that this robustness check can be treated only as a very rough one, since we do not have industry-specific measures of capacity utilisation at the level of detail in this study.

Finally, we check whether our main results are not driven by any single industry that is insignificant for the total economy. Looking at the value added

[24] This is the approach pursued by Cameron et al. (2005) in a similar setup covering UK manufacturing industries.

composition across industries in the central and eastern European Member States, the share of hotels and restaurants (NACE H) stands out as relatively small in all countries, while the coke and refinery industry (NACE DF) is virtually nonexistent in the Czech Republic, Estonia, Latvia, and Slovenia. Excluding these industries from our sample does not change the main results in a qualitatively significant way, however (see Table A3 in the Annex). This is the case for both the time series and the cross section approach.

7. Conclusions

The central and eastern European EU Member States have recorded impressive productivity gains over the past 15 years. At the broad sectoral level, manufacturing has been the main driver of productivity convergence, whereas gains in services have been less pronounced. Despite this catching-up process, however, a marked gap vis-à-vis the rest of the EU remains. Productivity gains have been accompanied by substantial inflows of FDI, particularly to financial and business-related services and, to a lesser extent, to industry. These general trends, however, mask important differences at the country and industry level.

The empirical results in this paper point to three main conclusions, which seem to be robust to a variety of tests. First, there is a strong convergence effect in productivity both at the country and at the industry level, i.e. productivity growth depends positively on its gap vis-à-vis the euro area. At the country level, this effect is highly pronounced in the Baltic region. At the industry level, the convergence effect is particularly strong in the manufacturing sector. Second, foreign capital, in the form of FDI inflows, plays an important role in accounting for productivity growth in the central and eastern European region. Third, the impact of FDI on productivity critically depends on the absorptive capacity. More specifically, the effect of FDI on productivity seems to be increasing with a declining productivity differential vis-à-vis the euro area. There is also evidence that the level of human capital is positively associated with a larger impact of FDI. The former type of interaction between absorptive capacity and the beneficial impact from FDI seems to be important in manufacturing, whereas the latter is more significant in services.

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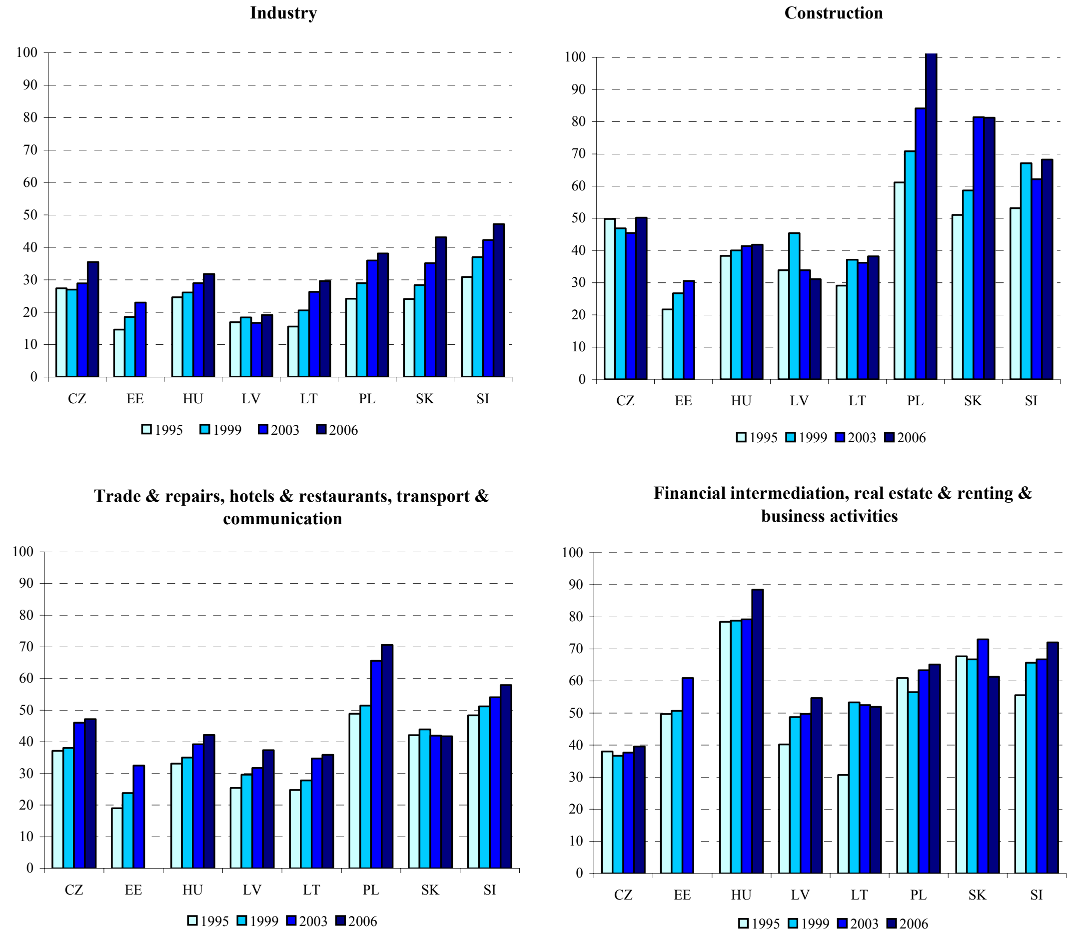
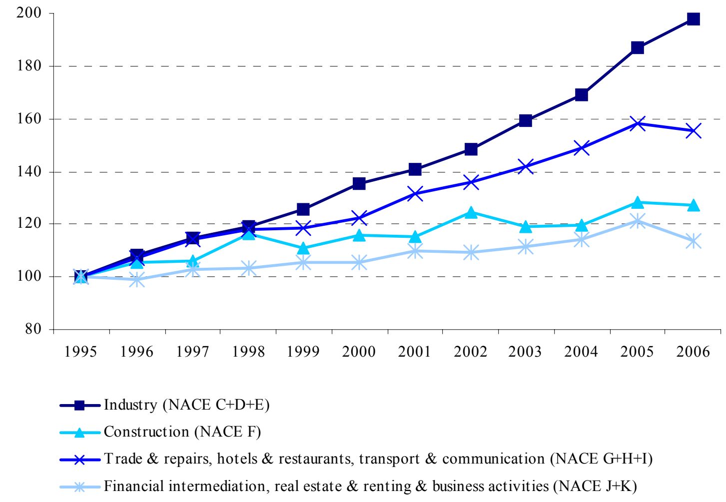
Chart 1 Labour productivity levels relative to the euro area

(euro area = 100)



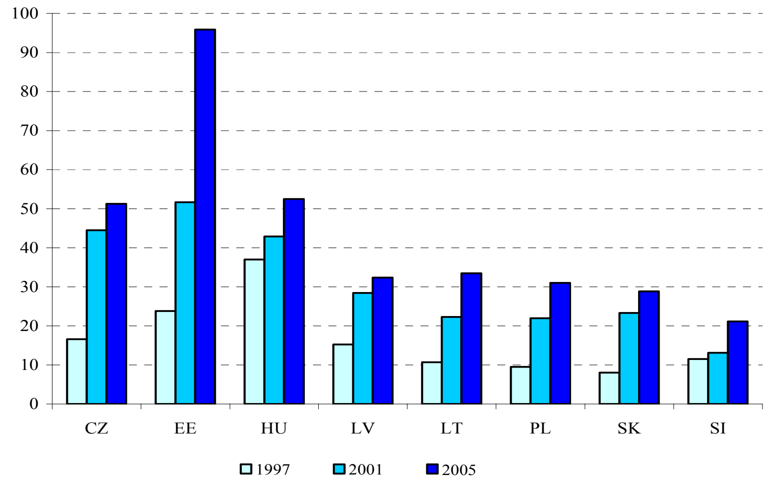
Source: EU KLEMS and Eurostat. Labour productivity is calculated as gross value added per hour worked. Level comparisons based on industry-specific PPPs.

Chart 2 Cumulative labour productivity growth by sector
(1995 = 100, unweighted average of CEE-8 countries)



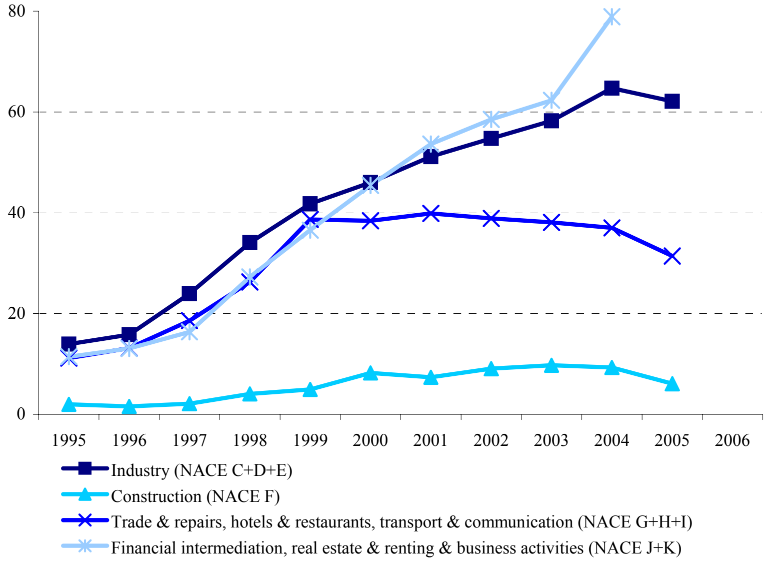
Source: EU KLEMS and Eurostat. CEE-8: CZ, EE, HU, LV, LT, PL, SK, SI.

Chart 3 FDI stock to GDP ratio
(in %)



Source: WIIW and Eurostat. Hungary: 1998 instead of 1997.

Chart 4 FDI stocks as a share of value added by sector
(in %, unweighted average of CEE-8 countries)



Source: WIIW, EU KLEMS and Eurostat. CEE-8: CZ, EE, HU, LV, LT, PL, SK, SI.
Note: Country composition changes due to differences in data availability (see country charts in the Annex).

Table 1. Data – Definitions of variables

Variable	Definition	Source	Availability
Labour productivity (LP)	Value added per hour worked	EU KLEMS	Total sample
Relative labour productivity (RLP)	Labour productivity level relative to the euro area	EU KLEMS	Total sample
Foreign Direct Investment (FDI)	Gross FDI inflow (calculated from the change in stocks) as a share of value added	WIIW database on Foreign Direct Investment in Central, East and Southeast Europe	Available for 1995-2005 for LT, LV, PL and SI, while from 1996(7) for the other countries
Total investment (INV)	Gross fixed capital formation as a share of value added	Eurostat (NewCronos)	Not available for EE, gaps for LV and SI
Human capital (HC)	Share of high-skilled workers in total hours worked	EU KLEMS	Not available for EE, LT and LV.
Import penetration (IMP)	Imports from EU-15 as a share of value added	WIIW Industrial Database Eastern Europe	Available for manufacturing only
R&D intensity (RD)	Business R&D expenditure as a share of value added	Eurostat	Wide coverage only for CZ, HU and PL
Capacity utilisation	Producers' assessment of the current level of capacity utilisation	European Commission Industry Survey	Available for manufacturing only

Note: Relative labour productivity levels vis-à-vis the euro area for 1997 are calculated using industry-specific purchasing power parities (PPPs). Estimates for the remaining years are extrapolated using labour productivity growth rates.

Table 2. Preliminary regressions

$\Delta\ln LP$	(1)	(2)	(3)	(4)	(5)
$\ln RLP$	-0.057*** (0.008)	-0.518*** (0.026)	-0.148** (0.064)	-0.045*** (0.006)	-0.064*** (0.010)
FDI	0.121*** (0.026)	0.064** (0.027)	0.129** (0.056)	0.117*** (0.027)	0.098*** (0.032)
Estimation Method	OLS	FE	GMM	OLS	SUR
Observations	1075	1075	1075	294	294

Notes: The estimations are performed using the ordinary least squares (OLS), fixed effects with a full set of country-industry dummies (FE), the system generalized method of moments (GMM) and the seemingly unrelated technique (SUR); for details on GMM and SUR estimations, see notes to Table 3 and Table 4, respectively; for the time-series approach (columns 1 to 3), the sample is an unbalanced panel of yearly observations covering the period of 1996-2005; for the cross-section approach (columns 4 and 5), each regression is a system of two equations, covering two five-year periods: 1996-2000 and 2001-2005; *LP* is labour productivity; *RLP* is labour productivity relative to that of the euro area; *FDI* is the foreign direct investment share in value added; numbers in parentheses are robust standard errors; *, ** and *** denote 10%, 5% and 1% statistical significance, respectively.

Table 3. System GMM estimation results

$\Delta\ln LP$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln RLP$	-0.148** (0.064)	-0.138*** (0.044)	-0.071** (0.032)	-0.098* (0.056)	-0.099* (0.053)	-0.152** (0.076)	-0.174** (0.074)
FDI	0.129** (0.056)	0.127*** (0.042)	-0.360 (0.282)	0.133*** (0.049)	0.050 (0.059)	0.152*** (0.055)	0.921*** (0.332)
INV		-0.006 (0.039)					-0.082 (0.053)
$FDI \cdot \ln RLP$			0.144* (0.079)				0.241*** (0.088)
HC				-0.027 (0.125)	-0.081 (0.141)	-2.695 (1.788)	-3.391** (1.645)
$HC \cdot \ln RLP$						0.654 (0.448)	0.820** (0.407)
$HC \cdot FDI$					0.479* (0.279)		0.670** (0.263)
Observations	1075	804	1075	617	617	617	534
Serial correlation test (p-value)	0.32	0.59	0.33	0.12	0.15	0.13	0.04
Hansen test (p-value)	0.33	0.46	0.25	0.32	0.38	0.45	0.90

Notes: The estimation is done using the system GMM technique; the sample is an unbalanced panel of yearly observations covering the period of 1996-2005; all regressions include a full set of time dummies; *LP* is labour productivity; *RLP* is labour productivity relative to that of the euro area; *FDI* is the foreign direct investment share in value added; *INV* is the gross fixed capital formation share in value added; *HC* is the share of high-skilled workers in employment; all regressors are lagged one year; numbers in parentheses are robust standard errors; the null hypothesis of the serial correlation test is that errors in the first differenced regression exhibit no second order correlation; the null hypothesis of the Hansen test is that the instruments are exogenous; *, ** and *** denote 10%, 5% and 1% statistical significance, respectively.

Table 4. SUR estimation results

$\Delta \ln LP$	(1)	(2)	(3)	(4)	(5)	(6)
ln*RLP*	-0.064*** (0.010)	-0.056*** (0.012)	-0.068*** (0.010)	-0.045*** (0.012)	-0.050*** (0.014)	-0.001 (0.020)
FDI	0.098*** (0.032)	0.159*** (0.058)	-0.093 (0.117)	0.190*** (0.055)	-0.004 (0.098)	0.105* (0.059)
INV		-0.020 (0.034)				
FDI · ln*RLP*			0.057* (0.034)			
HC				-0.306 (0.314)	-0.590* (0.350)	1.149** (0.531)
HC · ln*RLP*						-0.372*** (0.108)
HC · *FDI*					1.133** (0.471)	
Observations	294	232	294	172	172	172
R^2 for individual periods	0.61, 0.33	0.67, 0.38	0.62, 0.32	0.66, 0.45	0.66, 0.36	0.67, 0.43

Notes: The estimation is done using the SUR technique; each regression is a system of two equations, covering two five-year periods: 1996-2000 and 2001-2005; the estimation allows for different error variances in each equation and for correlation of these errors across equations; all regressions include a full set of country and industry dummies, the coefficients on which are allowed to vary across periods; other coefficients are constrained to be the same for both periods; *LP* is labour productivity; *RLP* is labour productivity relative to that of the euro area; *FDI* is the foreign direct investment share in value added; *INV* is the gross fixed capital formation share in value added; *HC* is the share of high-skilled workers in employment; all variables are expressed as five-year averages, except for *RLP*, which is measured for the year preceding the beginning of the relevant period; numbers in parentheses are robust standard errors; *, ** and *** denote 10%, 5% and 1% statistical significance, respectively.

Table 5. System GMM estimation results – manufacturing vs. services

$\Delta \ln LP$	(1m)	(1s)	(3m)	(3s)	(5m)	(5s)
ln*RLP*	-0.283** (0.113)	-0.066 (0.050)	-0.112** (0.045)	-0.051 (0.045)	-0.181* (0.100)	-0.028 (0.058)
FDI	0.123 (0.092)	0.129*** (0.039)	-0.543** (0.269)	0.263 (0.519)	0.214 (0.239)	0.060 (0.114)
FDI · ln*RLP*			0.223*** (0.086)	-0.035 (0.134)		
HC					-0.222 (0.411)	-0.085 (0.108)
HC · *FDI*					-1.681 (2.711)	1.464*** (0.386)
Observations	685	390	685	390	386	231

Notes: See notes to Table 3. The column numbers correspond to the relevant regressions in Table 3, with 'm' denoting manufacturing (NACE DA to DN, without DC), while 's' stands for services (including construction, NACE F to K).

Table 6. System GMM estimation results – CEE vs. Baltic countries

Δln*LP*	(1CE)	(1BL)	(3CE)	(3BL)
ln*RLP*	-0.131* (0.068)	-0.226*** (0.077)	-0.082 (0.072)	-0.151** (0.061)
FDI	0.127*** (0.041)	0.186* (0.107)	1.186** (0.516)	-0.559*** (0.193)
FDI · ln*RLP*			-0.288** (0.137)	0.227*** (0.072)
Observations	662	413	662	413

Notes: See notes to Table 3. The column numbers correspond to the relevant regressions from Table 3, with the following acronyms used for the two regions: CE (Central Europe: the Czech Republic, Hungary, Poland, Slovakia, Slovenia), BL (Baltic countries: Estonia, Latvia, Lithuania).

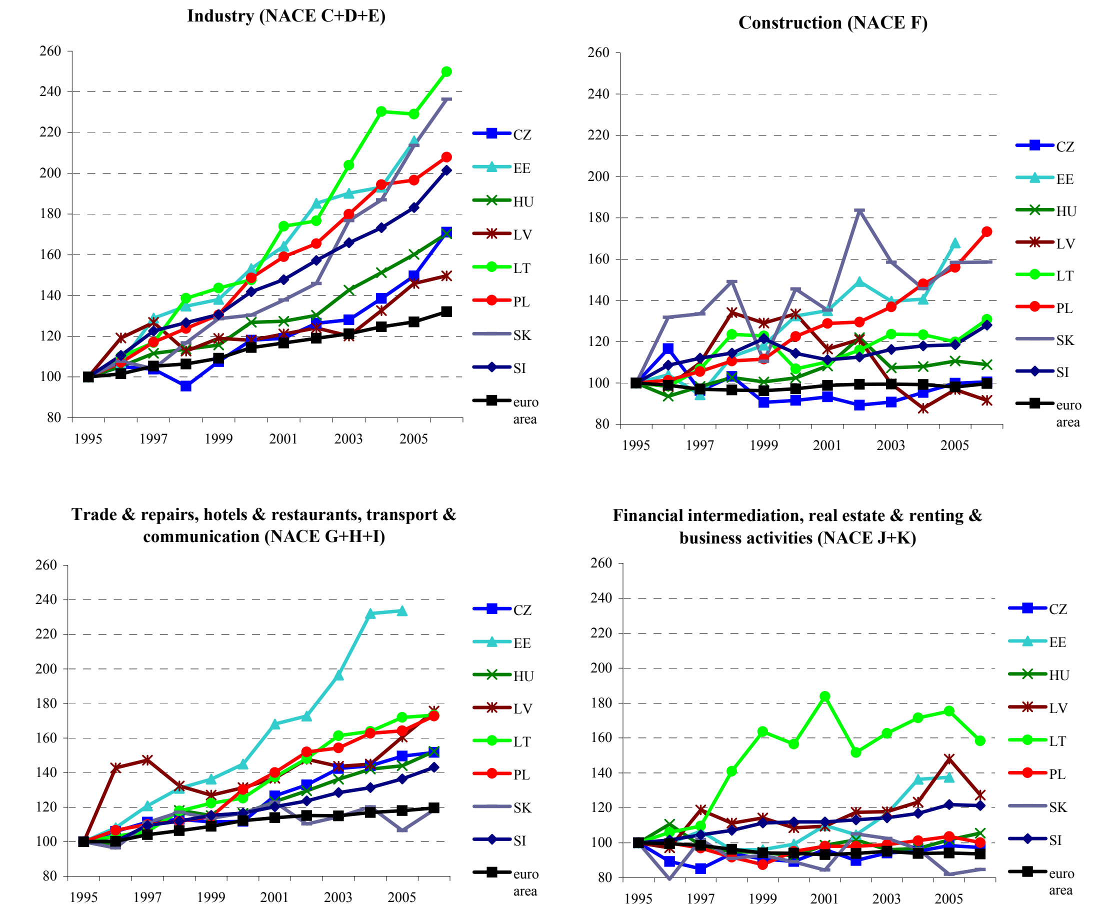
Table 7. Unrestricted SUR estimation results

Δln*LP*	(1_95-00)	(1_01-05)	(3_95-00)	(3_01-05)	(5_95-00)	(5_01-05)
ln*RLP*	-0.069*** (0.013)	-0.046*** (0.013)	-0.071*** (0.013)	-0.042*** (0.013)	-0.050** (0.100)	-0.035** (0.015)
FDI	0.063 (0.044)	0.114*** (0.038)	-0.410** (0.173)	0.430** (0.215)	-0.019 (0.140)	-0.036 (0.123)
FDI · ln*RLP*			0.155*** (0.056)	-0.080 (0.056)		
HC					-0.431 (0.438)	-0.669* (0.368)
HC · *FDI*					1.614* (0.937)	1.155** (0.544)
Observations	147	147	147	147	86	86

Notes: The difference compared to the regressions reported in Table 4 is that the estimation does not restrict any of the parameters to be equal across the two subperiods. Otherwise, see notes to Table 4. The column numbers correspond to the relevant regressions from Table 4, with '_95-00' denoting the first five-year period (1995-2000), while '_01-05' standing for the second period (2001-2005).

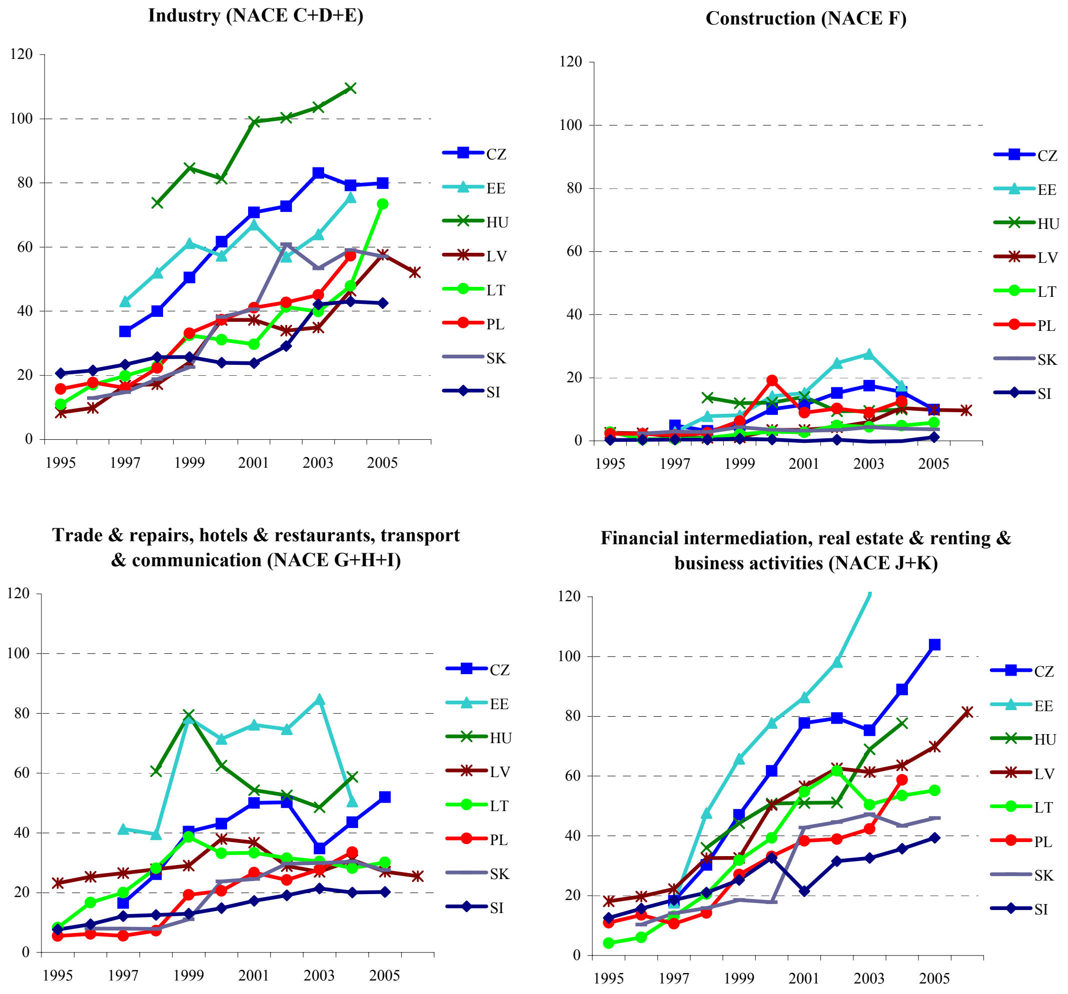
ANNEX

Chart A1. Cumulative labour productivity growth by country
(1995 = 100)



Source: EU KLEMS and Eurostat.

Chart A2. FDI stocks as a share of value added by country
(in %)



PM: Value for Estonia in 2004: 210.

Source: WIIW, EU KLEMS and Eurostat.

Table A1. Main results – industries C, E and DC included

ΔlnLP	(1_GMM)	(1_SUR)	(3_GMM)	(3_SUR)	(5_GMM)	(5_SUR)
ln*RLP*	-0.140*** (0.115)	-0.064*** (0.009)	-0.092*** (0.033)	-0.068*** (0.009)	-0.147** (0.063)	-0.048*** (0.012)
FDI	0.115** (0.053)	0.099*** (0.030)	-0.488** (0.237)	-0.119 (0.114)	0.081 (0.067)	-0.015 (0.085)
FDI · ln*RLP*			0.181** (0.071)	0.066** (0.033)		
HC					0.012 (0.154)	-0.137 (0.317)
HC · *FDI*					0.424* (0.252)	1.138*** (0.428)
Observations	1223	340	1223	340	672	192

Notes: The column numbers correspond to the relevant regressions from Table 3 (GMM) and Table 4 (SUR), see notes to these tables. Compared to the baseline, the sample also includes the following industries: mining and quarrying (NACE C), electricity, gas and water supply (NACE E) and manufacture of leather and leather products (DC).

Table A2. Main results – capacity utilization included

ΔlnLP	(1)	(3)	(5)
ln*RLP*	-0.165** (0.067)	-0.105*** (0.040)	-0.113** (0.053)
FDI	0.133** (0.057)	-0.380 (0.264)	0.046 (0.060)
FDI · ln*RLP*		0.151** (0.075)	
HC			-0.069 (0.142)
HC · *FDI*			0.489* (0.276)
Observations	1075	1075	617

Notes: The column numbers correspond to the relevant regressions from Table 3, see notes to this table. Compared to the baseline, capacity utilization is included as an additional regressor (not reported).

Table A3. Main results – industries H and DF excluded

$\Delta \ln LP$	(1_GMM)	(1_SUR)	(3_GMM)	(3_SUR)	(5_GMM)	(5_SUR)
$\ln RLP$	-0.136*** (0.048)	-0.046*** (0.009)	-0.066* (0.034)	-0.044*** (0.010)	-0.171*** (0.064)	-0.063*** (0.014)
FDI	0.101** (0.050)	0.118*** (0.027)	-0.465** (0.192)	-0.017 (0.038)	0.025 (0.069)	-0.010 (0.090)
$FDI \cdot \ln RLP$			0.165*** (0.055)	0.176* (0.137)		
HC					0.055 (0.177)	-0.424 (0.371)
$HC \cdot FDI$					0.475* (0.276)	1.078** (0.439)
Observations	993	274	993	274	564	160

Notes: The column numbers correspond to the relevant regressions from Table 3 (GMM) and Table 4 (SUR), see notes to these tables. Compared to the baseline, the sample excludes the following industries: hotels and restaurants (NACE H) and coke and refinery (DF).

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