Structure and Performance of the Service Sector in Transition Economies

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Abstract

This paper examines the performance of the service sector in the Eastern European transition economies during the 1997-2004 period. The performance of the service sector as a whole and of its sub-sectors is very heterogeneous within the region. Service sub-sectors that are information and communications technology producers or users and those using skilled labor more intensively exhibit the highest labor productivity growth. Our estimates show a positive and significant effect of liberalization on service labor productivity growth which is stronger for sub-sectors that are more distant from the technological frontier. Service liberalization is also shown to have a positive effect on labor productivity levels and growth of downstream manufacturing industries.

Keywords: services, productivity, transition economies, service liberalization
JEL: L8, L9, O14, O4, P2

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1. Introduction

Growth in the services sector and a decline in the agricultural sector are structural features of economic development (Chenery and Taylor, 1968). In OECD countries, the services sector represents more than two thirds of economic activity. In Eastern Europe and Central Asian (ECA) countries, the importance of the services sector for GDP and employment has substantially increased since the beginning of transition and accounts presently for more than half of the economic activity (World Bank, 2006).

An efficient services sector has direct consequences for economic growth. World Bank (2008) shows that the recent sectoral shift towards services has contributed to an increase in aggregate productivity in the ECA region. An efficient services sector also has indirect growth consequences through the efficiency of other sectors in the economy. High quality services such as transport or telecommunications affect production costs and thus the competitiveness and the degree of integration into global markets of firms in all sectors. Moreover, high-quality services can also influence the attractiveness of a location for foreign direct investment (FDI). Eschenbach and Hoekman (2006) show that ECA countries which have achieved since 1990 more progress in services sector policy reforms aimed at increasing efficiency have attracted more FDI and exhibited faster per capita GDP growth.

In this paper, we examine the structure and performance of the services sector in transition economies between 1997 and 2004 and the effect of services policy reforms on the performance of the services sector itself and on the performance of downstream manufacturing users. In the analysis we consider, depending on data availability, either the group of Eastern European (henceforth EE) countries plus Southeastern countries and Ukraine, or the group of Eastern European plus Baltic (henceforth EEB) countries, or a combination of countries from both groups. During the 1997-2004 period, services represent an increasing share of total value added and employment in the ECA region, averaging 46% and 31%, respectively. These percentages are not too distant from those in EU-15 countries, which is remarkable given the under-development of the services sector at the beginning of transition due to the primacy given to the manufacturing and agricultural sectors during the communist period.

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2 EE countries are those which joined the European Union on May 1st 2004: the Czech Republic, Hungary, Poland, the Slovak Republic, and Slovenia. EEB countries consist of EE countries plus Estonia, Latvia, and Lithuania which joined the European Union on the same date.

3 EU-15 countries are the European Union members prior to 2004: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.
Our main findings are as follows. First, the performance of the services sector as a whole and of its sub-sectors is very heterogeneous across ECA countries. A clear divide separates the substantially more productive EE countries from the Southeastern countries and Ukraine while a large productivity gap between EEB countries and EU-15 countries is shrinking due to strong productivity growth in most service sub-sectors in the EEB region between 1997 and 2004. Second, in EEB countries service sub-sectors that are information and communications technology (ICT) producers or users and those that use skilled labor more intensively exhibit substantially higher labor productivity growth than other sub-sectors. Third, our regression analysis for EEB countries uncovers evidence of faster labor productivity growth in service sub-sectors which have achieved more progress in policy reforms even after controlling for country-year interaction dummies or for sub-sector specific trends. This evidence is robust to a control for the effect of foreign direct investment (FDI) in service sub-sectors. Fourth, our regression results show that the positive effects of service deregulation and liberalization are stronger for the sub-sectors that are more distant from the technological frontier, measured by the average labor productivity in EU-15 countries. These results suggest that reductions in the restrictiveness of product market regulations affect the speed at which service sub-sectors in EEB countries catch up to the technological frontier by increasing competition and the incentives to invest in more advanced technologies. Finally, we find positive and significant effects of the liberalization of services on labor productivity levels and growth of downstream manufacturing users for the set of EE countries plus Bulgaria, Estonia, Lithuania, and Romania when country-year interaction dummies and country-industry dummies are also controlled for.

The paper is organized as follows. Section 2 describes the data and the structure of the service sectors in ECA countries while Section 3 examines the performance of the service sector. Section 4 examines the determinants of performance of service sub-sectors in ECA, particularly policy reforms. Section 5 investigates the effect of policy reforms in services on the performance of the manufacturing sector. Section 6 concludes.

2. Data and the Structure of the Services Sector

2.1 Data

The service sector covers a disparate set of activities ranging from electricity generation to banking or retail trade. Services can be divided into backbone services - activities that change or add value directly to other economic units or goods belonging to other economic
units (OECD, 2003) - and services for final consumption (e.g., hotel stays). In this study, we cover the NACE 2-digit sub-sectors 40-41 and 50-74 listed in Appendix Table 1. We use two data sources to cover the most recent transition period 1997-2004: (1) the WIIW Handbook of Statistics 2005: Central, East, and Southeast Europe from the Vienna Institute which covers service sub-sectors at a more aggregate level than NACE 2-digit for EE countries, Southeastern countries (Bulgaria, Croatia, Macedonia, Romania, Serbia and Montenegro), and Ukraine; and (2) the KLEMS database March 2008 release from the Groningen Growth and Development Center which covers sub-sectors at the NACE 2-digit level for EEB countries (Timmer et al., 2007a). When both databases are combined, or when yet another database is introduced in Section 5, we designate the group of countries by the expressions ‘ECA countries’, ‘ECA region’, or ‘ECA’. From the WIIW database we use for each country and sub-sector, data on gross value added and employment. From the KLEMS database, we use for each country and sub-sector data on gross value-added, employment, hours worked, output price deflators, and purchasing power parity (PPP) conversion rates. We rely on the two databases to describe the importance and recent performance of service sectors in ECA, but we focus on the KLEMS database to examine the correlates of service sub-sectors’ performance in Section 4, given that database’s measurement advantages highlighted in Section 3.

2.2 Importance of Services

In ECA, services represented on average 44.6% (31.4%) of total value added (employment) in the 1997-2000 period and that share increased substantially to 47.1% (32%) in the 2001-2004 period. These average shares are not too distant from the corresponding shares in EU-15 countries, which is remarkable given the under-development of the service sector early in the transition due to the primacy given to the manufacturing and agricultural sectors during the communist period. Services represent actually a higher share of value added in the Slovak Republic, Estonia, and Latvia than in EU-15 countries.

The main service sub-sectors in terms of their average contribution to value added in ECA during the 1997-2004 period are wholesale, retail, and repair of motor vehicles (13.4%).

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4 Note that in databases such as the World Development Indicators, NACE 40-41 - electricity, gas, and water - are part of the ‘industry’ sector, which is distinct from the ‘service’ sector.
5 Appendix Table 2 defines all variables used in the analysis showing the country and time coverage for each.
6 Services contribute generally higher shares to value added and employment in EEB countries than in other ECA countries.
real estate, renting, and business activities (12.5%) and transport, storage, and communications (10.6%) in the WIIW database. Focusing on the more disaggregated sub-sectors in the KLEMS database, the main contributors to value added in EEB countries are real estate activities (7.5%), wholesale trade (7%), retail trade (5.5%), inland transport (4.3%), legal, technical, and advertising activities (3.5%), and post and telecommunications (3.3%). The share of real estate activities in employment (1.5%) is much smaller than its share in value added, in contrast to the commensurate shares of other sub-sectors in value added and employment, which suggests an artificial inflation in this sub-sector’s value added, associated with a recent real estate boom in ECA. This boom increases artificially the sub-components ‘buying and selling of own real estate’ and ‘letting of own property’, since the latter imputes a rental value to homeowners, as shown by Crespi et al. (2006) for the UK. This could result in artificially high labor productivity in real estate activities that would not correspond to true efficiency. Hence, we exclude real estate activities from our labor productivity analysis based on the KLEMS database. Unfortunately, real estate activities are part of the aggregate ‘real estate, renting, and business activities’ in the WIIW database and thus cannot be excluded from the corresponding statistics reported in Section 3.

3. Services Sector Performance

3.1 Average Patterns

To describe the recent performance of service sectors in ECA we rely on labor productivity defined as the ratio of a measure of output to a measure of labor input. Defining output in services is intrinsically difficult (Griliches, 1992; Triplett and Bosworth, 2004). Given the heterogeneity across sub-sectors, the common practice is to use value measures of output. Crespi et al. (2006) argue that a sub-sector’s value of output is the value of the bundle of intermediation services provided, which is well captured by real value added when the service is based on a change in the condition of a consuming unit as in retail trade, but may be less well captured by real value added in legal, technical, and advertising activities. Nevertheless, we measure service output by real value added due to its wide cross-country and time coverage for ECA countries. For each service sub-sector, labor productivity is obtained either as (1) the ratio of real value added to total employment [employment-based

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7 Moreover, the use of value added instead of gross output is preferable since for each service sub-sector the countries covered may differ substantially in their usage of intermediate inputs relative to gross output.
labor productivity] or (2) the ratio of real value added to total hours worked [hours-based labor productivity], the latter being available only for the KLEMS database.

To perform cross-country comparisons of labor productivity levels within ECA, we need to transform a sub-sector’s nominal value added at domestic prices in domestic currency into real value added in a common unit across countries, while taking into account differences in the purchasing power of each country’s currency. Average exchange rates are inappropriate for this purpose since they reflect capital movements, monetary policy, and speculation, and do not adjust for differences in relative prices across countries. The appropriate procedure is to use purchasing power parity (PPP) conversion rates in order to express real value added in service sub-sectors across countries at a common set of prices in a common currency. Due to the differential type of information included in the WIIW database and the KLEMS database, we use different PPP conversion rates and thus different definitions of labor productivity for each service sub-sector and year in each country.

The WIIW database does not include output price deflators, hence we transform each service sub-sector’s nominal gross value added in domestic currency into real value added in PPP USD using a country-level GDP deflator and a 2001 country-level expenditure-based PPP, as described in Appendix B. Country-level expenditure-based PPPs convert domestic currency into PPP USD by equalizing the purchasing power of different currencies, thus eliminating the differences in price levels across countries. The employment-based labor productivity computed using this measure of real value added is henceforth designated as WIIW labor productivity. This approach - the only possible for the WIIW database - suffers from the drawback of not correcting for sub-sector specific domestic and international prices.

The KLEMS database includes value added price deflators and production-based PPPs that are sub-sector specific. Hence we transform each service sub-sector’s nominal gross value added in domestic currency into real value added in PPP euros using a sub-sector specific value added price deflator and a 1997 sub-sector specific PPP, as described in Appendix B. The employment-based [hours-based] labor productivity computed using this measure of real value added is henceforth designated as KLEMS employment-based labor productivity [KLEMS hours-based labor productivity].

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8 Timmer et al. (2007b) describe in detail the computation of production-based sector-specific PPPs. However, they argue that expenditure-based PPPs are a reasonable approximation for sub-sectors which produce mainly for final consumption and whose products are hardly internationally traded.
Appendix Figure C.1 illustrates the differences in the performance of services within ECA by showing unweighted (Panel A) and weighted (Panel B) averages of WIIW labor productivity taken across all sub-sectors in each country. A productivity divide separates the EE countries from the Southeastern countries and Ukraine, with the latter exhibiting generally lower productivity. Unweighted and weighted averages of WIIW labor productivity increase between 1997 and 2004 in all ECA countries. Appendix Figure C.2 shows unweighted (Panels A and C) and weighted (Panels B and D) averages of KLEMS employment-based and hours-based labor productivity taken across all 2-digit sub-sectors (except real estate activities) in each country. Average KLEMS labor productivity differs substantially across countries, with the EE countries exhibiting substantially higher productivity in services than Latvia and Lithuania. Unweighted and weighted averages of KLEMS labor productivity increase substantially between 1997 and 2004 in all EEB countries. Appendix Figure C.2 also shows a large gap in the average labor productivity of services in EEB countries relative to EU-15 countries. During the 2001-2004 period, the best performer Hungary exhibits a weighted average KLEMS hours-based labor productivity that is 56% of the EU-15 average, while the worst performer Lithuania exhibits an average productivity that is only 25% of the EU-15 average. However, between the 1997-2000 and the 2001-2004 periods the productivity gap between EEB countries and EU-15 countries shrunk due to the strong productivity growth experienced by service sectors in the EEB countries. However, these average patterns mask some heterogeneity across service sub-sectors, which we examine next.

### 3.2 Patterns across Sub-Sectors

Comparing a sub-sector’s labor productivity across countries can provide an insight on which economic environments foster better performance. However, this comparison is subject to a problem of cross-country heterogeneity in service prices and quality. Only the

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9 Weighted averages employ as weights each sub-sector’s share in total services value added.

10 Appendix Figures C.1 and C.2 differ in their labor productivity ranking of EE countries given (i) the different sub-sectors included in the average calculations, and (ii) the use of sub-sector specific prices for the averages in Figure C.2 which differs substantially from the use of aggregate prices for the averages in Figure C.1.

11 KLEMS employment-based or hours-based labor productivity for EU-15 countries is obtained as the average across all countries of KLEMS employment-based or hours-based labor productivity in all sub-sectors, where productivity for each sub-sector and EU-15 country is calculated in similar way to productivity for each sub-sector and EEB country. Considering a simple average of labor productivity across the more and less advanced EU-15 countries may underestimate labor productivity, hence, EEB countries may be more distant from the average productivity levels of the best EU-15 performers.
use of sub-sector specific production-based PPPs as in KLEMS labor productivity accounts for sub-sectoral differences in price levels across countries. To the extent that differences in prices reflect differences in quality, the use of sub-sector specific production-based PPPs also mitigates differences in the quality of services across countries. Since the number of hours worked is more comparable across sub-sectors and countries than the number of bodies working, our analysis below focuses on KLEMS hours-based labor productivity measures.

Average KLEMS hours-based labor productivity for NACE 2-digit sub-sectors, shown in Appendix Figure C.3, suggests a different ‘comparative advantage’ across EEB countries. Poland exhibits the highest productivity in wholesale trade, retail trade, inland transport, and financial intermediation.\(^\text{12}\) In post and telecommunications, Slovenia is the most productive while Estonia is the most productive in computer and related activities, R&D, and legal, technical, and advertising activities. The figure also benchmarks average KLEMS hours-based labor productivity in EEB countries relative to EU-15 countries for each sub-sector. Interestingly, while on average EU-15 countries exhibit substantially higher productivity than EEB countries, that is not the case in computer and related activities, R&D, nor legal, technical, and advertising activities for which Estonia displays the highest productivity.

Finally, we examine the geometric average annual growth rates of KLEMS hours-based labor productivity for disaggregated service sub-sectors across EEB countries shown in Appendix Figure C.4.\(^\text{13}\) There is enormous disparity in labor productivity growth rates across countries in all sub-sectors but for most sub-sectors and countries, labor productivity growth accelerates from the 1997-2000 period to the 2000-2004 period. Retail trade, post and telecommunications, and legal, technical, and advertising activities exhibit the strongest productivity growth. Note that for most service sub-sectors, average productivity growth in EU-15 countries (not shown) is lower than average productivity growth in EEB countries, which may reflect a catch-up effect given the large gap in productivity levels that separates EEB from EU-15 countries. But it may also reflect differences in economic growth trajectories, as some EEB countries exhibited strong GDP growth especially since 2001, while EU-15 countries exhibited weaker GDP growth. The accelerating labor productivity growth of service sectors in ECA since 2000 is prima facie evidence for the argument put forward by Van Ark and Piatkowski (2006) that the second ‘expansionary’ phase of sustained

\(^{12}\) Poland’s efficiency in retail trade is likely related to the presence of FDI in that sub-sector but a formal testing of this hypothesis is left for future research using firm-level data.

\(^{13}\) This comparison takes into account changes in sub-sector specific domestic and international output prices.
convergence of ECA countries towards EU-15 countries will rely importantly on service sectors.

4. Determinants of Service Sector Performance

Section 3 documents important differences in labor productivity levels and growth rates across service sub-sectors and countries within ECA. Understanding the determinants of these differences in performance is crucial for policy purposes. Some important factors that may underlie these differences in performance are capital intensity, market size and the scale at which services can be sold, human capital, technological innovations (particularly the use of ICT), and policies and institutions (Van Ark et al., 1999). Due to data limitations on the available correlates of service sub-sectors’ performance in ECA countries, we follow different approaches to examine the role of ICT, of skills, and of policy reforms and openness. Our analysis in this section focuses on growth in KLEMS labor productivity.

4.1 ICT

We assess the importance of ICT for the labor productivity growth of service sub-sectors in EEB countries relying on the taxonomy proposed by van Ark and Piatkowski (2004). A service sub-sector is categorized as an ‘ICT producer’ according to the OECD definition. Alternatively, a service sub-sector is categorized as an intensive user of ICT (‘ICT user’) or as a non-intensive user of ICT (‘Non-ICT’) based on the ICT capital share of the sub-sector using the US as a benchmark as in Van Ark et al. (2004), given that data on ICT investment for service sub-sectors is not available for ECA countries. Figure 1 shows average geometric growth in KLEMS hours-based labor productivity across EEB countries for each of the three ICT categories. As an average across all countries, ICT users exhibit the fastest productivity growth throughout the period. However, there is some heterogeneity across countries. During the 2000-2004 period, ICT users experience the fastest productivity growth in all EEB countries except Latvia. In Hungary, Latvia, Poland, and the Slovak Republic ICT producers experience faster productivity growth than non-ICT sub-sectors. For these countries one can hypothesize that the high productivity growth rates documented in

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14 The OECD categorizes as ICT producers the sub-sectors which produce IT hardware, communication equipment, telecommunications, or computer services (including software).
15 Appendix Table A.1 shows to which ICT category each of the NACE 2-digit service sub-sectors belongs.
16 Unreported results show that ICT users and ICT producers also exhibit substantially higher average KLEMS hours-based labor productivity levels than non-ICT sectors in all EEB countries during the sample period.
Section 3 for financial intermediation and for transport, storage, and communications (which include several ICT users) are correlated with the introduction of cost-reducing ICT. In Latvia, ICT producers exhibit the highest productivity growth rates during the 1997-2004 period. Note that these findings for service sub-sectors match those for manufacturing sub-sectors in ECA for which better performance is shown to be associated with the production or the use of ICT in World Bank (2008). The fact that labor productivity growth is higher for ICT users especially in the last part of the sample period suggests a progressive penetration of ICT in the service sectors of EEB countries. Time-varying data on ICT investments for service sub-sectors would be required for a more detailed analysis of the importance of the penetration and efficient use of ICT in services for sub-sectoral performance.

4.2 Skilled Labor

Next, we examine the role of skilled labor use for the labor productivity growth of service sub-sectors in ECA relying on the taxonomy proposed by O’Mahony and Van Ark (2003). Service sub-sectors are categorized as ‘high skill intensity’ or ‘low skill intensity’ based on the average educational attainment of individuals working in each sub-sector using the E.U. and the US as a benchmark, given that data on skills for service sub-sectors is not available for ECA countries. Figure 2 shows average annual growth in KLEMS hours-based labor productivity across EEB countries for the two skill categories. In all EEB countries except Latvia, high-skill-intensity service sub-sectors exhibit substantially faster productivity growth than low-skill-intensity sub-sectors in the 2000-2004 period, while the opposite is true for most countries in the 1997-2000 period. Again the findings for service sub-sectors match those for manufacturing sub-sectors in ECA for which better performance is shown to be associated with a more intensive use of skilled workers in World Bank (2008). The similarity of conclusions for the ICT and skill taxonomies is not surprising given that many of the high-skill-intensive sub-sectors are those which produce or use intensively ICT. Also, the less favorable performance of high-skill-intensive sub-sectors relative to low-skill-intensive sub-sectors during the 1997-2000 period raises the possibility that earlier in the transition ECA countries did not develop sufficiently the skills required to use intensively the new technologies. Again, time-varying data on the skill composition of the workforce in

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17 Appendix Table A.1 shows to which skill category each of the NACE 2-digit service sub-sectors belongs.
18 Unreported results show that high-skill-intensity sub-sectors also exhibit much higher average KLEMS labor productivity levels than low-skill-intensity sub-sectors in all EEB countries during the sample period.
service sub-sectors would be required for a detailed analysis of the effects of skills on sub-sectoral labor productivity growth.

4.3 Policy Reforms

We also examine whether the labor productivity growth of service sub-sectors across EEB countries is tied to the progress of policy reforms in these sub-sectors and to their degree of openness to FDI. Eschenbach and Hoekman (2006) and Arnold et al. (2007) provide a detailed description of the content of service policy reforms in ECA countries and illustrate the progress made by ECA countries in terms of liberalization. These policy reforms combine deregulation (e.g., the dismantling of barriers to entry and promotion of competition) and improved regulation (e.g., the setting up of an appropriate legal environment, strengthening and increasing the independence of regulatory agencies). On average, more progress in liberalization reforms has been achieved in the telecommunications and the electricity sub-sectors. However, despite significant progress, ECA countries still exhibit heavy product market regulations that stifle competition, growth, and innovation in their service sectors (OECD, 2005). Moreover, there is still significant cross-country heterogeneity in the degree of liberalization and the quality of the regulatory framework facing the service sector, which may help explain the differences in performance documented in Section 3.

To capture the extent of service liberalization across ECA countries, we use the European Bank for Reconstruction and Development (EBRD) index of progress in policy reforms which is sub-sector specific and time-varying over the 1997-2004 period. The service sub-sectors covered by the EBRD index are electric power, water distribution, road transport, telecommunications, banking reform and interest rate liberalization, and non-bank financial institutions which match almost perfectly the original NACE 2-digit sub-sectors or combinations of NACE 2-digit sub-sectors covered by the KLEMS database.

Before pursuing our regression analysis, we illustrate in Figure 3 the correlation between policy reforms measured by the EBRD index and performance measured by the average growth rate in KLEMS hours-based labor productivity of the corresponding service sub-sectors during the 1997-2004 period. The EBRD index ranges from 0 to 4 with higher

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19 We exclude from Figure 3 labor productivity growth in NACE 67 - activities auxiliary to financial intermediation. However, in the regression analysis, we attribute the values of the EBRD index for NACE 65 - financial intermediation - to NACE 67. The results are robust to the exclusion of NACE 67 from the sample.
values of the index indicating that more progress in liberalization has been achieved. The figure provides some evidence of stronger labor productivity growth in EEB countries where service policies have been more liberalized, but the relationship is unclear for service sub-sectors such as electricity and gas. This lack of clarity is not surprising given that the heterogeneity in demand conditions across countries, cyclical effects, technological progress, and other omitted factors can influence the productivity growth of different service sub-sectors across countries. Moreover, the use of period averages prevents us from exploiting the variation over time in the EBRD index and in labor productivity growth. The econometric analysis allows us to address these issues.

Table 1 shows the results from OLS regressions with robust standard errors (White correction for heteroskedasticity) of growth in KLEMS hours-based labor productivity (columns (1)-(6)) and of growth in KLEMS employment-based labor productivity (columns (7)-(12)) on the one-year lag of the EBRD index.20 Year dummies are included in all specifications in Table 1 (except those in columns (2), (5), (8), and (11)) to account for worldwide business cycles and other macroeconomic factors affecting equally all sub-sectors in all countries. Country dummies control for country-specific characteristics affecting both service productivity growth as well as the regulatory regime measured by the EBRD index, and they are also included in all specifications in Table 1 (except those in columns (2), (5), (8), and (11)).21 Since some of these country characteristics may vary over time, we include as an alternative country-year interaction dummies that account for heterogeneity in demand conditions and other cyclical conditions across EEB countries in the specifications in columns (2), (5), (8), and (11). Service sub-sector dummies are included in all the specifications in Table 1 to account for sub-sector specific time-invariant determinants of labor productivity growth that could also be potentially correlated with the EBRD index. For example, capital intensity is likely to differ substantially across service sub-sectors, but the KLEMS database does not include information on capital stocks, hence the sub-sector dummies help account for that. However, some of the potential joint determinants of the regulatory regime and of labor productivity growth in each service sub-sector, such as

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20 While the figures focus on the 1997-2004 period, the regression analysis uses data from the 1996-2004 period to avoid losing observations due to the consideration of growth rates and lagged EBRD indexes. The sample used for the specifications in Table 1 covers all the EEB countries and the sub-sectors electricity and gas (NACE 40), water (NACE 41), road transport (NACE 60), telecom (NACE 64), banking (NACE 65), and insurance (NACE 66).

21 This option is preferable to the inclusion of explicit time-varying country characteristics, given the limited degrees of freedom we have for our sample that covers only 8 EEB countries.
technological progress, vary over time and are therefore not captured by sub-sector dummies. Hence, the specifications shown in columns (3), (6), (9), and (12) include sub-sector specific time trends to account for shocks to a sub-sector that could influence both its productivity growth and the regulatory regime it faces.

The results shown in columns (2), (3), (8), and (9) in Table 1 suggest a positive and significant effect of service liberalization on the growth in KLEMS hours-based and employment-based labor productivity in EEB countries. It is interesting to note the increase in the magnitude and significance of the coefficient on the EBRD index when moving from column (1) to columns (2) or (3) (columns (8) or (9)). This increase suggests that the omission of time-varying country-specific factors or of sub-sector time trends correlated both with labor productivity growth and with the EBRD index biases downward the coefficient on the EBRD index. Our preferred specification is that shown in column (2) of Table 1 which controls for country-year interaction dummies in addition to service sub-sector dummies. The specifications shown in Table 1 were also estimated separately for each of three groups of service sub-sectors (electricity/gas/water, transport/telecommunications, and finance) and produced qualitatively similar (though somewhat weaker) patterns: i.e., higher labor productivity growth in sub-sectors with more liberalized policies.

One important issue to discuss is whether the estimated impact of the EBRD index on labor productivity growth in Table 1 is biased and can be interpreted as causal. The main argument in favor of causality is that the liberalization of services in EEB countries during the sample period was driven exogenously by the anticipation of the accession to the EU in 2004. However, one could argue that the differences in liberalization across service sub-sectors may have been partly driven by their productivity growth. The type of bias resulting from such endogeneity is ambiguous, though. On the one hand, better performing service sub-sectors may have lobbied EEB countries’ governments for further deregulation and for improved regulation, in which case an upward bias would be expected for the coefficient on the EBRD index. On the other hand, EEB countries’ governments may have liberalized more the regulatory regime in worst performing sub-sectors as an attempt to boost their performance, in which case a downward bias in the coefficient on the EBRD index would be expected. Our consideration of the effect of the one-year lagged, rather than the current, EBRD index on labor productivity growth helps to mitigate the potential endogeneity

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22 Note also that the inclusion of the interaction dummies adds substantial explanatory power to the regressions.
23 These results are available from the author upon request.
between the EBRD index and labor productivity growth. This is an appropriate procedure to employ given that labor productivity growth does not seem to exhibit serial correlation in the sub-sectors and countries covered by our sample. The inclusion of the various types of dummies and trends in the specifications shown in Table 1 also helps to address this problem. Finally, note that we obtain qualitatively similar results when considering the two-year lag of the EBRD index.

Our results in columns (2), (3), (8), and (9) in Table 1 are in line with the theoretical predictions discussed by Nicodème and Sauner-Leroy (2007) of improvements in productivity growth as a result of regulatory reforms and increased competition. A caveat of our analysis is that it focuses on labor productivity growth outcomes but multifactor productivity growth measures would be preferable since they take into account the importance of growth in service sub-sectors’ capital stocks. Nevertheless, our results provide a partial micro-foundation for the findings by Eschenbach and Hoekman (2006) of stronger per capita GDP growth in the transition economies which have achieved more progress in the liberalization of their service sectors after 1990. Our results for labor productivity growth are stronger than those obtained by Inklaar et al. (2008) who analyze the effect of the entry liberalization indexes from Conway and Nicoletti (2006) on the TFP growth of service sub-sectors for a sample including the US and 10 EU-15 countries. Once data on capital stocks for service sub-sectors in EEB countries becomes available it will enable the estimation of the link between EBRD indexes and TFP growth measures for those sub-sectors and thus a better comparison to the results obtained for advanced economies.

In addition to deregulation and improved regulation captured by the EBRD indexes, the stronger presence of FDI in some service sub-sectors and countries can help explain the corresponding differences in labor productivity growth. Disaggregated data on FDI stocks for each services sub-sector and EEB country is available from the WIIW Database on Foreign Direct Investment in Central, East and Southeast Europe for most of the sample period. Columns (4)-(6) and (10)-(12) of Table 1 show the results from specifications that include the lagged ratio of the FDI stock to the gross output in each service sub-sector, in addition to the lagged EBRD index. The effect of the EBRD index on labor productivity growth is generally unchanged and the FDI stocks exhibit a positive though weak association with labor productivity growth. In unreported regressions, we included the logarithm of the FDI stock

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24 Appendix Table A.2 lists the years of data that are available for each EEB country.
instead of the ratio of FDI stock to sectoral output and obtained qualitatively similar results. It is possible that the market share-stealing effects of FDI are counteracting to some extent the other benefits from competition and from knowledge spillovers and are therefore resulting in a weak effect of the FDI to output ratio on productivity growth.

4.4 Policy Reforms and Distance to Frontier

Our results so far suggest a positive impact of liberalization, product market competition, and deregulation reforms on the performance of service sub-sectors in EEB countries on average. However, the impact of these reforms is likely to differ across sub-sectors, depending on the technological environment in which they take place. Aghion and Howitt (2006) develop a Schumpeterian catching-up model where the effects of policies increasing competition and facilitating entry on productivity growth vary with a country’s or a sector’s distance to the technological frontier. Aghion et al. (2004) propose a Schumpeterian model where the entry threat from technologically advanced firms affects the innovative efforts of incumbent firms differentially depending on the initial state of technological development of the firms’ industry. The entry threat encourages innovation in industries that are close to the technological frontier, as successful innovation allows incumbents to escape that threat. In industries that are more distant from the frontier, the entry threat discourages innovation by reducing the incumbents’ expected rents from innovating.

To incorporate these ideas into our framework, we examine whether the effects of deregulation and liberalization (measured by the EBRD index) on labor productivity growth differ depending on whether a service sub-sector is close to or far from the technological frontier. The technological frontier for a service sub-sector and year is measured by the corresponding average labor productivity in EU-15 countries. Then, the gap of a service sub-sector of an EEB country and year relative to the technological frontier is given by the negative of the logarithm of the ratio between that sub-sector’s labor productivity and that sub-sector’s average labor productivity in EU-15 countries. One important caveat of this approach is that labor productivity measures are imperfect proxies for technology since they capture many other factors, including for example capital intensity. In any case, we estimate a variant of the specifications shown in columns (1)-(3) and (7)-(9) of Table 1 where the lagged EBRD index enters in levels but also interacted with the gap relative to the

---

25 The calculation of average productivity in EU-15 countries is described in Section 3.
technological frontier, and where the gap enters as a separate regressor. The corresponding estimates are shown in Table 2. The effect of regulatory reform is still positive and significant both for growth in KLEMS hours-based as well as employment-based labor productivity. More interestingly, the positive coefficients on the interaction term show that in EEB countries regulatory reform has stronger positive effects on labor productivity growth for the sub-sectors that are more distant from the technological frontier. The negative coefficient on the gap suggests that sub-sectors with a larger gap relative to the technological frontier exhibit weaker productivity growth. However, the marginal effect of the gap is actually positive, thus the evidence does not support a lack of convergence in the labor productivity of services sub-sectors between EEB countries and the average for EU-15 countries.\footnote{The marginal effect is the sum of the coefficient on the gap and the coefficient on the interaction term multiplied by the sample average of the EBRD index.}

One interpretation for the positive interaction between the EBRD index and the technological gap shown in Table 2 is that reductions in the restrictiveness of product market regulations affect the speed at which service sub-sectors in EEB countries catch up to the technological frontier by increasing competition and the incentives to invest in more advanced technologies. Our interaction effects are in line with those obtained by Conway et al. (2006) in regressions that explain labor productivity growth in the service sectors of 20 OECD countries.\footnote{Conway et al. (2006) are able to estimate richer specifications including time-varying sectoral information on human capital and on capital per worker which is not available for EEB countries.} However, while we also estimate a positive and significant effect of the EBRD index per se, Conway et al. (2006) find insignificant effects of their regulatory variable in levels. An increase in the capital intensity of services in EEB countries, particularly for sub-sectors that are lagging behind the technology frontier, may be underlying our estimated interaction effects. This possibility would suggest that the positive and significant effects estimated for our service labor productivity growth regressions might not be obtained if we estimated instead service TFP growth regressions, where the effect of capital intensity would be accounted for. Indeed, our results are much more clear-cut than those obtained by Inklaar et al. (2008) for TFP growth in service sub-sectors in the US and in 10 EU-15 countries. The authors find a stronger negative effect of entry barriers on the TFP
growth of market service sectors that are more distant from the technological frontier but the estimated effects are weak.\footnote{In that paper, the technological frontier is measured for each sub-sector and year by the highest TFP among the TFP levels of the US and each of the 10 EU-15 countries.}

We close this section with two important remarks. First, regulatory reforms in sub-sectors such as wholesale and retail trade which have generated substantial productivity growth in OECD countries as shown by OECD (2005) are not covered by the EBRD index. Assessing the effect of reforms in those sub-sectors in ECA countries should be the object of future research. Second, the liberalization of services can influence average performance in a sub-sector through several margins: by increasing average productivity growth for incumbent firms but also by allowing the entry of new firms, which are likely to be more innovative and successful in meeting consumer demand, and by encouraging the exit of less productive firms. Studying these margins would require the use of services firm-level census data which should be a priority for collection by statistical agencies in ECA countries as it would enable policy-makers to understand the dynamics of productivity and growth in their service sectors.

5. The Effect of Service Liberalization on Manufacturing

The performance of service sub-sectors is important per se as these sectors contribute an increasingly large share to the economies of the ECA region but also because services are important inputs for downstream users. Hence, improvements in the performance of service sectors related to liberalization and deregulation of product markets can be crucial for the promotion of growth. Indeed, Eschenbach and Hoekman (2006) show that progress in service policy reforms helps explain differences in economic growth across ECA countries since 1990. Focusing on the outcomes of deregulation, Francois and Woerz (2007) show that the increased openness of business services to exports and FDI has strong positive effects on the employment and value added outcomes of manufacturing industries in the OECD. Arnold et al. (2006) find a significant positive effect of service liberalization and FDI on manufacturing firms’ TFP in the Czech Republic.

In what follows we examine the effect of liberalization in services on (i) labor productivity levels and on (ii) labor productivity growth of downstream manufacturing industries for all or a subset of the following nine ECA countries: Bulgaria, the Czech Republic, Estonia, Hungary, Lithuania, Poland, Romania, Slovenia, and the Slovak Republic.
In case (i), we consider two dependent variables. Our main dependent variable is labor productivity for 2-digit NACE manufacturing industries in the nine countries computed based on data from the *WIIW Industrial Database Eastern Europe 2005* from 1996 to 2004.\(^{29}\) For each country and year, the log of labor productivity in a manufacturing industry is obtained as the log of the ratio of real output to total employment. The database does not include output price deflators, therefore we transform each manufacturing industry’s nominal output in domestic currency into real output in PPP USD using a country-level GDP deflator and a 2001 country-level expenditure-based PPP, as detailed in Appendix B for service value added. Our alternative dependent variable consists of relative labor productivity in a manufacturing industry expressed as a ratio to the average labor productivity in the manufacturing sector overall for each country and year taken from the *WIIW Industrial Database Eastern Europe 2005* from 1996 to 2004. For a given industry in a country a relative labor productivity of 0.8 for example indicates that the industry is 80% as productive as the manufacturing sector overall in that country. We should note that this measure suffers from an important caveat. If the industrial structure changes towards an allocation more in line with comparative advantage - a process which is likely to be occurring in transition economies - then overall labor productivity in manufacturing may increase and an industry’s relative labor productivity will decrease even if that industry’s actual labor productivity remains unchanged.\(^{30}\) Also, note that the comparison of levels of this relative labor productivity measure across countries is not meaningful, hence it is essential to control for country dummies in all the regressions that use it as a dependent variable.

In case (ii), our dependent variable is the annual growth in labor productivity for 2-digit NACE manufacturing industries in seven ECA countries taken from the *WIIW Handbook of Statistics 2005: Central, East and Southeast Europe* from 1996 to 2004.\(^{31}\)

In the regressions corresponding both to cases (i) and (ii), our independent variable is a measure of liberalization in service sub-sectors weighted by the reliance of a given manufacturing industry on inputs from each service sub-sector. An input-output matrix for each of country is used to capture the dependency between service sub-sectors and manufacturing industries. More specifically, the independent variable is given by

\(^{29}\) Note that this database covers a mix of ECA countries some of which are covered also by the WIIW database and some of which are covered also by the KLEMS database.

\(^{30}\) We thank a referee for suggesting this caveat.

\(^{31}\) This database does not cover Estonia nor Lithuania.
\[ \text{services} \_\text{weighted} \_\text{EBRD}^c_{it-1} = \sum_k a^c_{ik} \ast \text{EBRD}^c_{it-1}, \]

where \( a^c_{ik} \) is the quantity of inputs sourced by manufacturing industry \( i \) from service sub-sector \( k \) as a fraction of the total inputs used by manufacturing industry \( i \) and \( \text{EBRD}^c_{it-1} \) is the EBRD index of progress in policy reform in service sub-sector \( k \) in year \( t-1 \).\(^{32}\) The service sub-sectors included in the weighted average are: electricity and gas (NACE 40), water (NACE 41), road transport (NACE 60), telecom (NACE 64), banking (NACE 65), and insurance (NACE 66). The use of lagged values of the EBRD index allows time for the effects of liberalization to materialize. We should note that this type of weighted indexes of regulatory impacts was first introduced by Conway et al. (2006) for OECD countries. The authors proposed the concept of ‘knock-on’ effects of anti-competitive regulation in service sectors or indexes of regulatory impact defined to be the effects of regulation on other sectors (such as manufacturing) that rely on services as intermediate inputs.

Interestingly, we find that the usage of inputs from service sub-sectors by manufacturing industries varies greatly across ECA countries. Appendix Figure D.1 shows the intensity of usage of each of the service sub-sectors for which the EBRD index is available by the manufacturing sector overall and by two manufacturing industries of different technological content: textiles and textile products (relatively low-tech) and electrical and optical equipment (relatively high-tech).\(^{33}\) For the manufacturing sector overall, inputs from electricity, gas, and steam represent the highest share of total inputs used in almost all ECA countries, ranging from an average of 2.3% of total inputs used in the Czech Republic to an average of 11% of total inputs used in Romania.\(^{34}\) Across ECA countries with the exception of Lithuania and Romania, inputs from electricity, gas, and steam represent a higher share of the total inputs used by textiles and textile products than of those used by electrical and optical equipment. The second most important services sub-sector in terms of input provision to the manufacturing sector overall is road transport. Incidentally, these findings show that the production process - i.e., the type of services inputs used and the intensity of their usage - of any given manufacturing industry differs substantially across countries.

\(^{32}\) The input-output tables provide information on input usage by each 2-digit NACE manufacturing industry from each 2-digit NACE service sub-sector and from all sectors in the economy, which allow us to calculate \( a^c_{ik} \).

\(^{33}\) In the figure, for each country and service sub-sector, the intensity of the manufacturing sector overall is obtained as an average of the linkage coefficients \( a^c_{ik} \) across all manufacturing sub-sectors.

\(^{34}\) Note that in the Czech Republic inputs from road transport represent a higher share of total inputs.
Table 3 shows the results from OLS regressions with robust standard errors (White correction for heteroskedasticity) of labor productivity levels and labor productivity growth on the aforementioned weighted index of service liberalization. Country-year interaction dummies account for heterogeneity in demand conditions and other cyclical conditions across ECA countries affecting labor productivity levels or growth as well as the regulatory regime and the intensity of usage of services by downstream manufacturing industries, and are included in all the specifications in Table 3. Labor productivity levels and growth rates differ across manufacturing industries due to the nature of their production processes, for example related to capital intensity. Moreover, different time-invariant determinants of labor productivity levels and growth potentially correlated with the industries’ intensity of usage of services may differ across countries, therefore the inclusion of country-industry interaction dummies in all the specifications in Table 3 is crucial. In particular, in labor productivity growth regressions country-industry interaction dummies can account for technological progress which may affect both the intensity of usage of services by each manufacturing industry in a given country as well as its productivity growth.

Arnold et al. (2006) argue that the liberalization of services in the Czech Republic can be considered exogenous to manufacturing productivity since the European Commission exerted a tight supervision on policy reform in preparation for that country’s accession to the EU in 2004. A similar argument applies to the other ECA countries included in our analysis, even Bulgaria and Romania which joined the EU only in 2007. Thus, we are not too concerned about reverse causality problems in the regression results shown in Table 3. Columns (1) and (2) of Table 3 show positive and significant effects of services liberalization on labor productivity levels of downstream manufacturing industries in ECA countries. We should note that our specifications in Table 3 borrow from the methodology introduced by Rajan and Zingales (1998) in that they achieves identification by examining within-country differences across manufacturing industries. More precisely, the different degrees of dependence of

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35 This option is preferable to the inclusion of explicit country-level time-varying characteristics, given that our degrees of freedom are limited in that dimension, as the sample covers only seven or nine ECA countries.

36 The sample used for the specifications in Table 3 covers all the NACE 2-digit manufacturing industries: food products/beverages/tobacco; textiles/textile products; leather/leather products; wood/wood products; pulp/paper/paper products/publishing/printing; coke/refined petroleum products/nuclear fuel; chemicals/chemical products/man-made fibers; rubber/plastic products; other non-metallic mineral products; basic metals/fabricated metal products; machinery and equipment not elsewhere classified; electrical and optical equipment; transport equipment; manufacturing not elsewhere classified. The countries covered are the Eastern European countries plus Bulgaria, Estonia, Lithuania, and Romania in columns (1)-(2), and the Eastern European countries plus Bulgaria and Romania in column (3).
manufacturing industries on inputs from service sub-sectors which have attained different degrees of liberalization are the crucial interaction term. The coefficients on the service weighted lagged EBRD index shown in columns (1) and (2) of Table 3 indicate that, within ECA countries, manufacturing industries that rely more heavily on inputs from more liberalized service sub-sectors exhibit significantly higher productivity levels than manufacturing industries that rely less heavily on those inputs.

The estimate shown in column (3) of Table 3 indicates that service liberalization also leads to an acceleration in the growth rate of labor productivity of downstream manufacturing industries in ECA countries. Specifically, the estimate shows that, within ECA countries, manufacturing industries that rely more heavily on inputs from more liberalized service sub-sectors exhibit significantly faster productivity growth than manufacturing industries that rely less heavily on those inputs. Finally, note that the results in columns (1)-(3) are qualitatively similar when two-year lags of the EBRD index are used in the calculation of the service weighted lagged EBRD index.

5. Conclusion

This paper examines the trends in the structure and performance of service sectors in ECA countries during the 1997-2004 period, which represent an increasing share of total value added and total employment in the region. A clear divide separates the substantially more productive Eastern European countries from the Southeastern countries and Ukraine while a large productivity gap between Eastern European plus Baltic countries and EU-15 countries is shrinking due to strong productivity growth in most service sub-sectors between 1997 and 2004. In Eastern European plus Baltic countries, service sub-sectors that are ICT producers or users or those that use skilled labor more intensively exhibit substantially higher growth in labor productivity. Our regression analysis for Eastern European plus Baltic countries shows a robust positive effect of services deregulation and liberalization on the growth in labor productivity of service sub-sectors. These positive effects are shown to be stronger for the service sub-sectors that are more distant from the technological frontier in EU-15 countries. Finally, we find positive effects of service liberalization on the levels and growth in labor productivity of downstream manufacturing industries for the set of Eastern European countries plus Bulgaria, Estonia, Lithuania, and Romania.

Our evidence suggests a potential for service-driven productivity growth in the ECA region if policy-makers pursue further liberalization efforts, for example by removing the
product market barriers still limiting competition in various service sub-sectors and by allowing and attracting more FDI. Services liberalization is likely to also benefit the performance of the manufacturing sector. Moreover, reductions in the restrictiveness of product market regulations in services seem to benefit more the service sub-sectors that are farther away from the technological frontier and therefore can help the convergence towards EU-15 levels. Productivity growth in services in the ECA region may also benefit from the continued penetration of advanced technologies such as ICT as well as from skills development.
References


Figure 1: Average KLEMS Hours-Based Labor Productivity Growth and ICT

Note: For each country and ICT category, the figure shows the simple average taken across all service sub-sectors in that category of their geometric averages of annual growth rates in KLEMS hours-based labor productivity in the 1997-2000 and the 2000-2004 periods.
**Figure 2: Average KLEMS Hours-Based Labor Productivity Growth and Skills**

Note: For each country and skill category, the figure shows the simple average taken across all service sub-sectors in that category of their geometric averages of annual growth rates in KLEMS hours-based labor productivity in the 1997-2000 and the 2000-2004 periods.
Figure 3: Policy Reform and KLEMS Hours-Based Labor Productivity Growth

Notes: For each country and service sub-sector, geometric averages of annual growth rates in KLEMS hours-based labor productivity in the 1997-2004 period are shown. Financial intermediation is NACE 65 category.
<table>
<thead>
<tr>
<th></th>
<th>KLEMS Hours-Based Labor Productivity</th>
<th>KLEMS Employment-Based Labor Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Lagged EBRD Index</td>
<td>0.019</td>
<td>0.052</td>
</tr>
<tr>
<td></td>
<td>[0.025]</td>
<td>[0.024]**</td>
</tr>
<tr>
<td>Lagged FDI to Output Ratio</td>
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<td>0.075</td>
</tr>
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<td></td>
<td>[0.075]</td>
<td>[0.076]</td>
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<td>Yes</td>
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<td>Country Dummies</td>
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<td>Yes</td>
</tr>
<tr>
<td>Sub-Sector Dummies</td>
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<td>Yes</td>
</tr>
<tr>
<td>Country-Year Interaction Dummies</td>
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<td>Yes</td>
</tr>
<tr>
<td>Sub-Sector Trends</td>
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<td>Yes</td>
</tr>
<tr>
<td>N. Observations</td>
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<td>428</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.09</td>
<td>0.19</td>
</tr>
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</table>

Notes: OLS estimation is used. Robust standard errors in brackets. ** and * indicate significance at the 5% and 10% confidence levels, respectively. The countries covered in the specifications are the Eastern European plus Baltic countries and the service sub-sectors covered are electricity and gas (NACE 40), water (NACE 41), road transport (NACE 60), telecom (NACE 64), banking (NACE 65), and insurance (NACE 66).
### Table 2: Distance to the Frontier and Differential Effects of Liberalization on Service Labor Productivity Growth

<table>
<thead>
<tr>
<th></th>
<th>Dependent Variable is:</th>
<th>KLEMS Hours-Based Labor Productivity</th>
<th>KLEMS Employment-Based Labor Productivity</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td>(1) (2) (3) (4) (5) (6)</td>
<td></td>
</tr>
<tr>
<td>Lagged EBRD Index</td>
<td>0.134</td>
<td>0.232</td>
<td>0.215</td>
</tr>
<tr>
<td></td>
<td>[0.058]**</td>
<td>[0.071]***</td>
<td>[0.071]***</td>
</tr>
<tr>
<td>Lagged EBRD Index * Lagged Gap Rel. to Technological Frontier</td>
<td>0.344</td>
<td>0.514</td>
<td>0.503</td>
</tr>
<tr>
<td></td>
<td>[0.133]***</td>
<td>[0.163]***</td>
<td>[0.153]***</td>
</tr>
<tr>
<td>Lagged Gap Relative to Technological Frontier</td>
<td>-0.090</td>
<td>-0.128</td>
<td>-0.120</td>
</tr>
<tr>
<td></td>
<td>[0.038]**</td>
<td>[0.046]***</td>
<td>[0.043]***</td>
</tr>
<tr>
<td>Year Dummies</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Country Dummies</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Sub-Sector Dummies</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Country-Year Interaction Dummies</td>
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<tr>
<td>N. Observations</td>
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<td>428</td>
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<tr>
<td>R-Squared</td>
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<td>0.24</td>
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Notes: OLS estimation is used. Robust standard errors in brackets. ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively. The countries covered in the specifications are the Eastern European plus Baltic countries and the service sub-sectors covered are electricity and gas (NACE 40), water (NACE 41), road transport (NACE 60), telecom (NACE 64), banking (NACE 65), and insurance (NACE 66).
Table 3: Effects of Service Liberalization on Manufacturing Labor Productivity Levels and Growth

<table>
<thead>
<tr>
<th></th>
<th>Log of Labor Productivity</th>
<th>Relative Labor Productivity</th>
<th>Labor Productivity Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Service Weighted Lagged EBRD Index</td>
<td>0.427</td>
<td>0.437</td>
<td>29.941</td>
</tr>
<tr>
<td></td>
<td>[0.191]**</td>
<td>[0.187]**</td>
<td>[15.298]*</td>
</tr>
<tr>
<td>Country-Year Interaction Dummies</td>
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<td>Yes</td>
</tr>
<tr>
<td>Country-Industry Interaction Dummies</td>
<td>Yes</td>
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<td>Yes</td>
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<tr>
<td>N. Observations</td>
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<td>945</td>
<td>776</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.97</td>
<td>0.96</td>
<td>0.37</td>
</tr>
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</table>

Dependent Variable is:

Notes: Robust standard errors in brackets. ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively. The sample used for the specifications covers all the NACE 2-digit manufacturing industries: food products/beverages/tobacco; textiles/textile products; leather/leather products; wood/wood products; pulp/paper/paper products/publishing/printing; coke/refined petroleum products/nuclear fuel; chemicals/chemical products/man-made fibers; rubber/plastic products; other non-metallic mineral products; basic metals/fabricated metal products; machinery and equipment not elsewhere classified; electrical and optical equipment; transport equipment; manufacturing not elsewhere classified. The countries covered in the specifications are the Eastern European countries plus Bulgaria, Estonia, Lithuania, and Romania in columns (1)-(2), and the Eastern European countries plus Bulgaria and Romania in column (3).
## Appendix A

### Appendix Table A.1: Sectoral Classification of Services

<table>
<thead>
<tr>
<th>Sub-sectors in KLEMS database - NACE 2-digit</th>
<th>Sub-Sector Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Electricity, gas, steam and hot water supply (Non-ICT) [High skill]</td>
</tr>
<tr>
<td>41</td>
<td>Collection, purification and distribution of water (Non-ICT) [High skill]</td>
</tr>
<tr>
<td>50</td>
<td>Sale, maintenance and repair of motor vehicles and motorcycles; retail sale services of automotive fuel (Non-ICT) [Low skill]</td>
</tr>
<tr>
<td>51</td>
<td>Wholesale trade and commission trade, except of motor vehicles and motorcycles (ICT user) [Low skill]</td>
</tr>
<tr>
<td>52</td>
<td>Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (ICT user) [Low skill]</td>
</tr>
<tr>
<td>55</td>
<td>Hotels and restaurants (Non-ICT) [Low skill]</td>
</tr>
<tr>
<td>60</td>
<td>Land transport; transport via pipelines (Non-ICT) [Low skill]</td>
</tr>
<tr>
<td>61</td>
<td>Water transport (Non-ICT) [Low skill]</td>
</tr>
<tr>
<td>62</td>
<td>Air transport (Non-ICT) [High skill]</td>
</tr>
<tr>
<td>63</td>
<td>Supporting and auxiliary transport activities; activities of travel agencies (Non-ICT) [High skill]</td>
</tr>
<tr>
<td>64</td>
<td>Post and telecommunications (ICT producer) [High skill]</td>
</tr>
<tr>
<td>65</td>
<td>Financial intermediation, except insurance and pension funding (ICT user) [High skill]</td>
</tr>
<tr>
<td>66</td>
<td>Insurance and pension funding, except compulsory social security (ICT user) [High skill]</td>
</tr>
<tr>
<td>67</td>
<td>Activities auxiliary to financial intermediation (ICT user) [High skill]</td>
</tr>
<tr>
<td>70</td>
<td>Real estate activities (Non-ICT) [High skill]</td>
</tr>
<tr>
<td>71</td>
<td>Renting of machinery and equipment without operator and of personal and household goods (ICT user) [High skill]</td>
</tr>
<tr>
<td>72</td>
<td>Computer and related activities (ICT producer) [High skill]</td>
</tr>
<tr>
<td>73</td>
<td>Research and development (ICT user) [High skill]</td>
</tr>
<tr>
<td>74a</td>
<td>Legal, technical, and advertising (ICT user) [High skill]</td>
</tr>
<tr>
<td>74b</td>
<td>Other business activities (Non-ICT) [High skill]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub-sectors in WIIW database</th>
<th>Sub-Sector Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>40+41</td>
<td>Electricity, gas, and water</td>
</tr>
<tr>
<td>50+51+52</td>
<td>Wholesale, retail, and repair of motor vehicles</td>
</tr>
<tr>
<td>53</td>
<td>Hotels and restaurants</td>
</tr>
<tr>
<td>60+61+62+63+64</td>
<td>Transport, storage, and communications</td>
</tr>
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<td>65+66+67</td>
<td>Financial intermediation</td>
</tr>
<tr>
<td>70+71+72+73+74a+74b</td>
<td>Real estate, renting, and business activities</td>
</tr>
</tbody>
</table>

Notes: * indicates a slight modification from the original NACE 2-digit classification made by the KLEMS database. In the original classification, 74a and 74b are a single category NACE 74 entitled ‘Other business activities’. In parenthesis () and [] we show the classification of each sub-sector according to the role of ICT and skills discussed in Section 4.

### Appendix Table A.2: Data Description and Variable Definitions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP deflator</td>
<td>From World Development Indicators. Coverage: 1997-2004 for Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Serbia and Montenegro, Slovak Republic, Slovenia, and Ukraine.</td>
</tr>
<tr>
<td>Value added</td>
<td>KLEMS database - services                                                                ♂ Gross value added measured at current basic prices expressed in millions of domestic currency for each service sub-sector. Coverage: 1996-2004 for Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, Slovenia, and EU-15 countries. For Latvia, Italy, and Ireland data from NACE 40 and 41 is aggregated.</td>
</tr>
<tr>
<td><strong>Employment KLEMS database - services</strong></td>
<td>Total number of employees in thousands for each service sub-sector. Coverage: 1996-2004 for Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, Slovenia, and each of the EU-15 countries. For Latvia, Italy, and Ireland data from NACE 40 and 41 is aggregated.</td>
</tr>
<tr>
<td><strong>Output deflator KLEMS database - services</strong></td>
<td>Gross output deflator for each service sub-sector. Coverage: 1996-2004 for Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, Slovenia, and each of the EU-15 countries. For Latvia, Italy, and Ireland data from NACE 40 and 41 is aggregated.</td>
</tr>
<tr>
<td><strong>Production-based PPP - services</strong></td>
<td>Relative ratio between domestic price level and German price level in 1997 for each service sub-sector divided by the 1997 exchange rate of domestic currency against euros. Coverage: 1997 for Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, Slovenia, and each of the EU-15 countries. For Latvia, Italy, and Ireland data from NACE 40 and 41 is aggregated.</td>
</tr>
</tbody>
</table>
Appendix B: Computing Real Value Added

1. Expenditure-Based PPP Conversion Rates
To transform nominal value added from the WIIW database, we use expenditure-based PPPs in 2001 for ECA country $c$ $PPP_{2001}^c$ (relative to the USD) backdated and updated to cover our sample period 1997-2004 using GDP deflators for each ECA country $c$ $P_t^c$ relative to the United States (US) $P_t^{US}$ as follows:

$$PPP_t^c = \left( \frac{P_t^c}{P_t^{US}} \right) * PPP_{2001}^c \quad (B1)$$

Then, we use these PPP conversion rates to transform gross nominal value added in country $c$ sub-sector $j$ and year $t$ expressed in local currency units $Y_{jt}^c$ into real value added in 2001 PPP USD: $RY_{jt}^c = Y_{jt}^c / PPP_t^c$.

2. Production-Based PPP Conversion Rates
To transform nominal value added from the KLEMS database, we use production-based sub-sector-specific PPPs in 1997 for ECA country $c$ $PPP_{1997}^c$ (relative to the Euro) backdated and updated to cover our sample period 1997-2004 using sub-sector specific output price deflators for each ECA country $c$ $P_t^c$ relative to Germany $P_t^G$ as follows:

$$\overline{PPP}_{jt}^c = \left( \frac{P_t^c}{P_t^G} \right) * PPP_{1997}^c \quad (B2)$$

Then, we use these PPP conversion rates to transform gross nominal value added in country $c$ sub-sector $j$ and year $t$ expressed in local currency units $Y_{jt}^c$ into real value added in 1997 PPP Euros: $\overline{RY}_{jt}^c = Y_{jt}^c / \overline{PPP}_{jt}^c$. 

32
Appendix C

Appendix Figure C.1: Average WIIW Labor Productivity in the Services Sector

Panel A. Unweighted Avg. Labor Prod.


Note: The averages of labor productivity are taken across the 6 sub-sectors listed in Appendix Table A.1. The weighted averages employ as weights each sub-sector’s share in total services value added.

Appendix Figure C.2: Average KLEMS Labor Productivity in the Services Sector

Panel A. Unweighted Avg. Employment-Based Labor Prod.


Panel C. Unweighted Avg. Hours-Based Labor Prod.

Panel D. Weighted Avg. Hours-Based Labor Prod.

Note: The averages of employment-based and hours-based labor productivity are taken across 19 NACE 2-digit sub-sectors listed in Appendix Table A.1 excluding real estate activities (NACE 70). The weighted averages employ as weights each sub-sector’s share in total services value added.
Appendix Figure C.3: Average KLEMS Hours-Based Labor Productivity in Service sub-sectors

Wholesale Trade

Retail Trade

Inland Transport

Post & Telecommunications

Financial Intermediation

Computer & Related Activities

R&D

Legal, Technical & Advertising Activities


Note: In this figure, financial intermediation is NACE 65 category.
Appendix Figure C.4: Average Annual Growth in KLEMS Labor Productivity in Service sub-sectors


Notes: For each ECA country and sub-sector, geometric average annual labor productivity growth rates for the 1997-2000 and 2000-2004 periods are shown. For EU-15 countries the growth rate of each sub-sector shown is the simple average across all EU-15 countries of their sub-sector’s geometric average annual labor productivity growth rates in the 1997-2000 and the 2000-2004 periods. In this figure, financial intermediation is NACE 65 category.
Appendix D

Appendix Figure D.1: Intensity of Usage of Inputs from Service sub-sectors by Manufacturing Industries

Source: Input-output tables described in Appendix Table A.2.