# What Determines Services TFP Growth: Services Trade or Services-Trade Regulation?

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**Abstract**

What determines services TFP growth: Is it services trade or services-trade regulation? To respond to this question I use four indicators of international trade in services since 1990 – namely FDI inward stock, services imports, domestic sales of foreign affiliates (FATS) and FDI inflows – to examine what type of services trade directly affects TFP growth. Subsequently, I analyze what type of trade-related regulation with respect to what type of services trade has played an inhibiting effect on services TFP growth. Such analysis contrasts with former studies in which mainly factor intensities are used to explain TFP growth. To find out what determines services TFP growth is important as some personal services such as health and education demonstrate a clear productivity lag, which according to the Baumol theory could eventually slow down real economic growth. I find that not trade but regulation forms a significant determinant for services TFP growth and that this effect is more pronounced for services sectors that are more distant from the technology frontier. Contrary to these findings, restrictions that are targeted to Mode 3 trade, i.e. FDI, seem to have a larger effect for services sectors that are closer to the technology frontier – presumably because spill-over effects from high-skilled labor are hindered to create higher TFP growth.

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## 1 Introduction

It's a stylized fact of economic development that the share of services in GDP and employment rises as per capita income increases. Today services occupy the biggest part of the developed OECD economies, around 70 to 75 per cent of their national GDP. At the same time services are being considered as the major driver of overall productivity growth.[1] Productivity growth differences in services across countries mirrors to a great extent aggregate growth differences. It's found that multi-factor productivity (TFP) in services are an essential factor in explaining these productivity growth differences across countries.[2] This marks services sectors and their TFP growth as a central element in the development of a national economy.

What then are the sources of such TFP growth differences in services across countries? Previous studies analyzing this question favor the conclusion that factor intensities are the major determinants for this question. Many services sectors today have experienced a concentration of ICT in their production process which would have increased TFP growth. A second often mentioned factor is the growth share of high-skilled labor that would stimulate technological innovation as opposed to imitation. These factors, however, cannot sufficiently explain TFP growth across countries, as shown in various econometrical works by Inklaar, Timmer and Ark (2008). There is, however, minor support for other factors such as entry-barriers although the results are not very clear-cut.

Therefore other factors may have played a decisive role in explaining TFP growth differences. These factors would include changes in returns to scale, increased competitive pressure, a lower use of inputs, or organizational transformations and management innovations brought in by foreign companies.[3] The focus of this article is therefore on the proposition that trade forming a channel to transmit these efficiency forces becomes a major explanatory variable for services TFP growth. Such a link might even be more important for services than for goods: the delivery which requires simultaneous production and consumption constitutes the competitive element for a services in which the aforementioned efficiency factors are more intensively exercised than in producing goods.

In spite of such supposed causal link between trade and productivity, services trade is to a great extent inhibited by domestic regulation through various modes of supply affecting international trade and eventually productivity. It therefore becomes imperative study the sectoral *trade*-related regulatory measures, such as entry regulation and regulation behind the border, as well as specific regulations targeted to mode 3 trade. Accordingly the question in this paper becomes to what extent

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1 For lowest-income countries services to GDP is substantially lower, around 35 percent of their national GDP, but still considerate. Standard explanations of the services to GDP ratio revolve around both demand and supply side factors. See e.g. Baumol (1967), Fuchs (1968, 1981), Kravis, Heston and Summers (1983), Inman (1985) and Francois and Reinert (1996).

2 See van Ark, Inklaar and McGuckin, (2003), Blanchard (2004) and van Ark, Timmer and Inklaar (2008)

3 See Financial Times (2009) for an example in postal communication services.

TFP growth in services is determined by international services trade or services trade-related regulation next to factor accumulation.

The link between services trade and productivity is particularly important as it is supposed that personal services such as health and education show a productivity lag as a consequence of their unfeasibility to substitute labor for other more productive factors of production. If trade and/ or trade-related regulation directly affects the sectors' TFP growth rate, one would expect large gains from the tradability and deregulation of these personal services sectors.

The results of this paper suggest that not trade but regulation is the main significant determinant of services TFP growth – even corrected for endogeneity. Furthermore, I find that that this effect is more pronounced for services sectors that are more distant from the technology frontier. However, restrictions in mode 3 seem to have a larger effect for services sectors that are closer to the technology frontier – most likely because spill-over effects from high-skilled labor would be held up to create higher TFP growth. This last hypothesis is strongly confirmed when FDI restrictions are interacted with the growth share of high-skilled labor in services.

The paper is structured as follows. The next section provides a literature overview of the productivity issues in services together with some descriptive productivity statistics. Section 3 describes the data sources and explanations together with their limitations for the econometrical specification. Section 4 and 5 presents the estimation results for trade and regulation respectively. Finally, section 6 offers concluding remarks.

## 2 Productivity and Services

### 2.1 Services and their "Perceived" Productivity Problem

There has been a long-standing concern about a perceived trade-off between the size of the services sector within an economy and the level of productivity because services suffer from an perceived productivity lag (Baumol and Bowen, 1966; Baumol, 1976)[4]. This so-called Baumol disease implies that the production process of a services is more costly relative to other (manufacturing) sectors, which causes them to experience a lower output and higher prices in the long run. These costs would stem from the unfeasibility of substituting labor into more productive factors of production compared to manufacturing where wages are tied to their productivity. The limited scope for labor productivity improvements causes services to represent an ever growing par of the economy. This eventually results in an decreasing overall economic growth.

[4] See for recent empirical contributions Nordhaus (2006) and Hartwig (2008).

However, many services perform an intermediary role in the production process. Francois (1990a) notes that the growth of these services sectors is an important determinant of overall economic growth and development because they allow specialization to occur.[5] The growth of a firm causes labor to specialize, which in turn means that more tasks are devoted to coordinating and organizing the core business of companies to increase firm productivity. These activities play a separate role in the production processes in order to generate more differentiated goods and to realize scale economies. The associated organizational innovations and growing coordination (network) services yields productivity gains that should affect economy-wide growth performance (Hoekman and Francois, 2008).

Oulton (2001) makes the theoretical case that all services are used as input into further production of final goods sectors that show a higher rate of productivity growth. The perceived productivity lag of these expanding "stagnant" services may even increase economic growth. The rationale behind is that greater outsourcing of services by (productive) firm in non-stagnant sectors requires a reallocation of factors that increase overall output and aggregate productivity.[6] Kox (2003) provides minor empirical support showing that business services in the Netherlands both expanded quickly in the 1990s and demonstrated stagnating productivity growth. However, in addition to these reallocation forces, services also form a mechanism to diffuse knowledge and spill-overs. This creates innovative production and organizational techniques within firms that would in turn allow for even further productivity increase.

Moreover, Oulton's (2001) argument fails to recognize that services are heterogeneous in both nature and function. The diversity of services characteristics may help to explain their experienced increase or decrease in productivity growth. Even within the more homogeneous category of business services large TFP growth differences are observable. For instance, the nature of a telecommunication service is different than a transport service. The former has experienced a fundamental change in efficiency due to ICT investments whilst the latter is much less receptive to such innovation. This is perhaps best proven by Triplett and Bosworth (2004) who show that both labor productivity and TFP for several US services have been growing – notably in financial and distribution services. However, the authors conclude that next to these ICT developments, TFP growth may actually be due to the use of managerial innovations and new concepts of doing business.

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[5] See also Burgess and Venables (2004) on the importance of a variety of services "inputs" that support specialization, creation and diffusion of knowledge, and exchange.

[6] In a related analysis, Fixler and Siegel (1999) argue that outsourcing of services by manufacturing firms may show up in short terms divergences in measured productivity growth of services vs. manufacturing sectors.

## 2.2 Personal Services Productivity

The function of services matter too. Not all services share the productivity-enhancing role of inputs into further production. Some are final-demand services serving the personal needs of end users. These personal service represent a substantial and growing part of all OECD economies.[7] Although great measurement issues of productivity in this type of services exist, if productivity in these services are lower than in manufacturing the Baumol theory is still likely to hold. Sasaki (2007) provides a model that integrates both arguments of Baumol (1967) and Oulton (2001) and makes a distinction between services as inputs (business services) and services as final-demand goods (personal services). It is shown that the rate of economic growth will decline in the long run irrespective of the size of the elasticity of substitution between labor and services inputs.[8]

On the other hand, this debate does not consider the final demand of personal services as inputs into the overall economy's production function. For instance, both health and education services have a function of contributing to the development of human capital and formation of R&D. Pugno (2005) shows that this would enhance productivity and eventually also economic growth across industry sectors. However, just modeling these personal services as inputs to the overall economy is not sufficient. Pugno (2005) continues to argue that the long-run consequences of human-capital accumulation depend crucially on a "once and for all" increase in productivity and quality. Accordingly, a policy intervention to stimulate and regulate productivity and quality in health and education becomes particularly pressing.

## 2.3 Services Productivity: Does Services Trade Play a Role?

An early strand of literature deals with services trade and productivity in the manufacturing services.[9] In a case study Arnold, Javorcik and Mattoo (2007) find that the performance of domestic

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7 Messerlin and van der Marel (2009) calculate that the share of output for Health and Education as part of total goods output represents 2 per cent and 15 per cent respectively for the EC19, and 34 per cent and 35 per cent respectively for the US.

8 However, it is assumed that the rate of productivity growth in both types of services is lower than in manufacturing. Data must show whether this is assumption holds.

9 Major new evidence for gains from trade through access to new imported inputs rather than existing ones for manufacturing firms has recently been provided by Goldberg, Khandelwal, Pavcnik and Topalova (2009). The authors show that through input import liberalization the range of products manufactured by the firm increases, which is an important component of TFP. Within the broader literature on trade liberalization and productivity changes, this study is placed next to Melitz (2003) and Pavcnik (2002) that put forward evidence of productivity improvements stemming from reallocation effects due to output tariff liberalization. As noted in the previous section, the empirical part of this paper focuses on the effects of services imports on the services sectors themselves whilst considering services either as further inputs to other manufacturing or services production or as final-end consumer services. Recent empirical work that focus on the link between trade liberalization and TFP is given by e.g. Kasahara and Rodrigue (2008) and Amiti and Konings (2007). The fact that Goldberg, Khandelwal, Pavcnik and Topalova (2009) do not use TFP is much related to identification problems of a clear link between trade liberalization and using firm's revenue to calculate TFP when using firm-level data.

manufacturing firms in the Czech Republic is much associated with FDI in services.[10] They conclude that the establishment of foreign services firms is a very strong and robust variable for explaining the TFP in user firms.[11] Francois and Woerz (2008) particularly examine the role of services as inputs to manufacturing. One important result they find is the significant and strong positive effect from increased services business openness in the form of services trade and FDI flows in skill and technology intensive industries. They further find that such positive link would stem from off-shoring of business services, which promotes the competitiveness of these higher-end services industries.

A subsequent question arises whether openness also affect the performance of domestic services sectors as opposed to only manufacturing sector. In this respect, some sector-specific studies particularly support the link between services productivity and *domestic* services openness. Fink, Mattoo and Rathindran (2003) have analyzed the impact of specific policy changes during the process when telecommunications became less state-supplied. They find that both privatization and creating domestic competition leads to significant improvements in labor productivity. A case study by Cammins and Rubio-Misas (2006) show significant TFP increase for the Spanish insurance industry during the 1990s after the introduction of an EU insurance Directive. However, this productivity growth was largely due to domestic firm-growth through M&A that took place, rather than to "managerial attention on cost-minimization" or "through technical improvements".

Next to these domestic reallocation effects, growth literature focuses on factor accumulation such as high-skilled labor (Aghion, Meghir and Vandenbussche, 2006) or ICT-capital (Triplett and Bosworth, 2008) to explain productivity growth. Growth of high-skilled labor stimulates innovation as opposed to imitation where in the case of the former high productivity gains can be expected. The use of ICT makes input use more efficient and therefore creates higher TFP growth. Although the mere growth of these factors may well explain TFP growth, the way *how* these factors are utilized may have as much a decisive role in explaining TFP growth. These gains rather correspond to how skills and ICT are exploited such as the efficient operation of returns to scale, lower use of foreign input after receiving foreign investment, or organization transformations and management innovations brought in by foreign companies.[12]

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[10] A related paper from Eschenbach and Hoekman (2006) assesses the positive link at the aggregate level between the level of services liberalisation and economic growth (and thus implicitly productivity) for transition economies for the period 1990-2004. Furthermore, Mattoo, Rathindran and Subramanian (2006) provide evidence that openness in the financial and telecommunications sectors influences long-run growth performance using a sample of 60 countries over the 1990-1999 period.

[11] Also, developing country-specific studies analyzing the link between services liberalization and manufacturing firm productivity. Arnold, Mattoo and Narciso (2006) found evidence for a positive and significant link between African manufacturing firms and their access to and performance in communications, electricity and financial services. Arnold, Javorcik, Lipscomb and Mattoo (2008) found similar evidence for banking, telecommunication and transport services liberalization reforms on Indian manufacturing firms for the period 1993-2005.

[12] As explained in Inklaar, Timmer en Ark (2008), Hulten, (2001) the level and growth of TFP can be caused by several factors. Under the neo-classical framework it strictly includes technological change and innovation, but several other important factors might comprise TFP such as organizational and institutional change and newly developed managerial innovations, plus chances in returns to scale. TFP also includes the effects from unmeasured inputs, such as research and development and other intangible assets.[12] Lastly, industry level TFP also reflects

International trade as a transmitter of the efficiency-enhancing skills and ICT might then become a determinant of TFP growth. In contrast to goods the nature of services may require these measures more intensively, mainly stemming from their features of joint consumption and production and non-storability. The competitive element of services centers around its delivery, which in turn is to a great extent associated with more advanced activities that deal with coordination, organization and network management. TFP gains in services would then spring from how efficiently these activities are exploited with help from high-skilled labor or ICT investments and optimal allocation of these activities may take place through international trade.

However, as noted in Hoekman and Mattoo (2008), Francois and Hoekman (2009), Nicoletti (2001) and Nicoletti and Scarpetta (2003), insofar most countries are similar in regard to openness to foreign competition, domestic regulatory policies that segments markets may become a major determinant of diverging productivity performance. Inklaar, Timmer and van Ark (2008) partly deal with this question and find that entry barriers are only to some extent negatively associated with services TFP growth. Furthermore and somewhat surprisingly, the authors find that the growth of factor accumulation such as high-skilled labor and ICT capital have no significant power to explain services TFP growth.[13]

This paper builds on the econometrical works of Inklaar, Timmer and van Ark (2008) by addressing the question whether international trade in services or services-trade regulation determines services TFP growth. By not including services trade Inklaar, Timmer and Ark (2008) do not make clear whether services trade as a direct impact on service TFP growth, i.e. one has to drop the assumption that all countries have similar levels of openness. Furthermore, I analyze whether other types of regulation by way of including "regulation behind the border" and restrictions targeted to trade in mode 3, play an additional effect on services TFP growth. Last, this paper includes all four types of services trade in an attempt to examine through which mode regulation has a particular negative effect.

## 3 Descriptive Statistics on Services Productivity

Data from the EUKlems should shed some light on the productivity statistics. This database has a TFP measure that is calculated by subtracting the cost-share weighed share in hours worked by different types of high, low and medium skilled workers, different types of capital (ICT or non-ICT)

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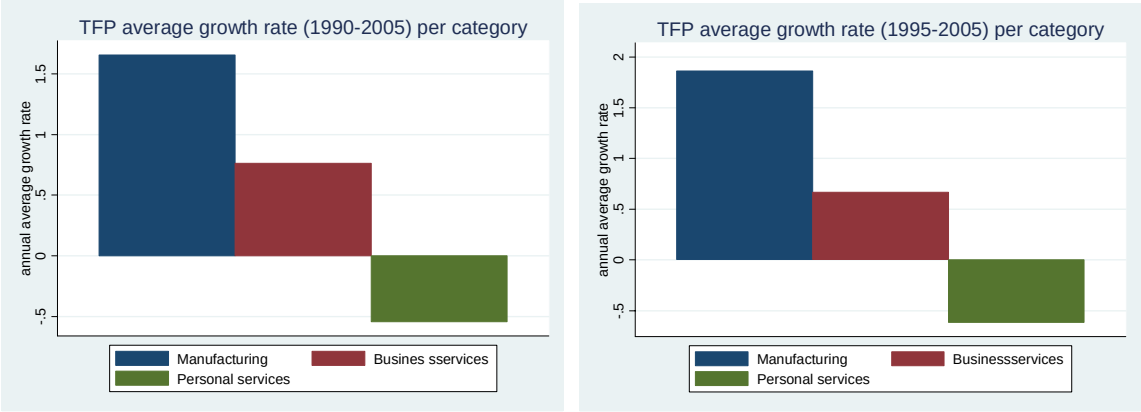
increased competitive market pressures that eventually measures a higher output through for example liberalization or a lower input use through privatization of public firms.

[13] The possibility of foreign services firms as a channel of technology diffusion and other positive dynamic effects from trade liberalization and regulatory reform has been documented by Nielson and Taglioni (2003). It supports the idea that this would increase the efficiency and competitiveness of the domestic economy. However, their focus is mainly on the manufacturing.

and intermediate inputs use from the share of gross output at constant prices.[14] Figure 1 in the annex show simple output-based TFP level in index form for both business and personal services for 20 countries staring in 1990.[15] What immediately stands out are the considerable differences between countries for business services productivity over time. High increases of TFP level are visible for Korea, Hungary, Finland and the UK whereas Australia France and Germany show moderate increase. Others show a decrease.

Figure 1: TFP annual average growth rate for 16 OECD countries.




Source: Author's calculations based on EUKlems data.

The trend of productivity levels are reflected in their growth rate. The figures presented in Figure 1 in the text above gives the annual average growth rate in TFP for manufacturing, business services and personal services for both from 1990-2005 and 1995-2005.[16] It clearly shows that manufacturing has experienced high TFP growth of around 1.5 per cent, but this is mere a reference to the services categories. Business services have on average experiences positive TFP growth since 1990 of around 0.7 per cent. This may confirm the notion that despite its lower growth rate compare to manufacturing these services can be seen as direct contributors to the overall economy.

Figure 1 furthermore clearly shows that the personal services are the great laggards. Their annual average growth rate is far lower than the business services sectors. For many countries these services

14 Details of this database and how TFP is calculated can be seen in appendix A. TFP calculation in the EUKlems database is according to calculations explained by Timmer, O'Mahony and Ark (2008). The EUKlems database shows a combination of 2-digit and 3-digit sectors. This descriptive section concentrates on the unweighted averages of the 3-digit sector levels.

15 Slovenia is excluded in this section. Indexes that show TFP level developments starting in a later year are according to their data availability in the EUKlems database.

16 Business services in this figure include Hotels and Restaurants, which might have reduced the annual average growth rate for the business sector. Extra countries for time period 1995-2005 include Czech Republic, Hungary, Ireland, Portugal and Slovenia. Furthermore, Authors of the EUKlems database (Timmer, Inklaar en Ark, 2008) mention that figures for these "non-market" services should be considered with care. TFP data in business services are considered to be reliable.

sectors show a negative trend and when averaged they show a -0.5 per cent growth rate for both time periods. Similar conclusions are found in Eichengreen and Gupta (2009) in where the authors calculated a annual average growth rate of -0.5 to -1.0 for personal services using similar data source. Overall it strongly confirms Sasaki's assumption that business services show lower productivity growth rate than manufacturing and that in turn personal services show lower rates than both manufacturing and business services.[17]

Table 1: Annual average TFP figures for 1990-2005 for main OECD countries per industry category.

| Country | Manufacturing | Business services | Personal services |
|---|---|---|---|
| Australia | 0.390 | 1.304 | -0.374 |
| Austria | 2.898 | 0.056 | -0.404 |
| Belgium | 0.760 | -0.346 | -0.565 |
| Denmark | -0.026 | 0.432 | -0.464 |
| Finland | 3.232 | 1.428 | -1.406 |
| France | 2.297 | 1.013 | -0.178 |
| Germany | 1.674 | 1.034 | 0.493 |
| Italy | 0.172 | 0.829 | -0.386 |
| Japan | -0.029 | 0.633 | -0.190 |
| Korea | 4.051 | 2.123 | -0.780 |
| Luxembourg | 1.988 | 0.199 | -1.875 |
| Netherlands | 1.416 | 0.971 | -0.908 |
| Spain | 0.012 | -0.643 | -0.745 |
| Sweden | 3.747 | 0.569 | -0.088 |
| UK | 1.172 | 1.528 | -0.535 |
| US | 2.727 | 1.069 | -0.270 |

Source: Author's calculations, based on EUKlems data.

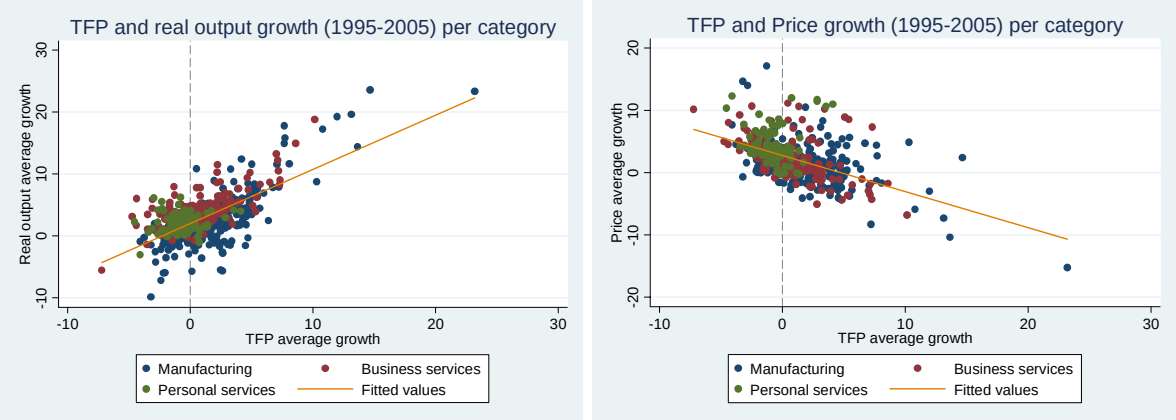
Admittedly, there are great differences in annual average TFP growth rates between countries. Table 1 shows per sector category which countries have experienced greater TFP growth since 1990. Again, countries such as France and Finland show higher growth rates in their Business services sector compared to other countries. Spain, Belgium and Austria are in this respect the laggards with negative annual average growth rates for business services. These are similar findings as presented in the growth accounting method by Inklaar, Timmer and Ark (2008).[18] Personal services are clearly the ones that show negative growth rates for all countries, except Germany that has a positive growth rate of around 0.5. Luxembourg, Finland and the Netherlands showing the lowest growth rates.

[17] Although the assumption did not require the productivity rate in personal services to be smaller than in business services.

[18] Furthermore, a detailed table showing annual average growth rate since 1995 shows that for example the US has experienced higher TFP growth, which confirms the calculations of simple growth rates increases for market services by Triplett and Bosworth (2006) and Timmer, Inklaar en Ark (2008) that the US show strong productivity growth increases since 1995 due to a large TFP increase together with ICT capital deepening.

The differences in average productivity growth among manufacturing, business and personal services also become visible in extended cross-country analysis from 1995 to 2005. Figure 2 shows, as economic theory predicts, that productivity growth rate is positively associated with real output growth and negatively associated with the price index growth. Interestingly, the graph reveals that within both business services and manufacturing a linear relationship is observable whilst that of personal services is not.[19] It implies that some factors over the years have affected several business services sectors to experience a higher output with lower prices as a result of higher productivity growth. The graph also reveals that TFP growth for personal services largely clusters around zero or becomes even negative.

Figure 2: TFP and real output growth (1995-2005) annual averages




Source: Author's calculations with EUKlems data.

How services sectors themselves can experience higher productivity growth, and whether this may come from trade in these services or may be inhibited by services trade regulation is the empirical question of this paper.

## 4 Services Trade as a Determinant for Services Productivity?

This section provides the econometrical specification and detailed description of the data used, and subsequently presents the estimation results.

[19] See for further information van der Marel (2009) and similar relationships with panel data analysis

### 4.1 Baseline Model Specification

The following sub-sections in this paper perform regression analyses of TFP growth in the services sectors on the four indicators of international trade. The baseline specification dictates that each of the trade indicators are regressed separately so as to see what their individual marginal effect is on services TFP growth. To avoid omitted variable bias we include both the share of high-skilled labor and ICT capital as these variables observations differ per year in the panel. Taking into account the fixed effects for country, sector and year the following econometrical model will be estimated:

$$\begin{aligned} \text{TFP}_{ijt} = \quad & \alpha + \beta_1 \text{Techgap}_{ijt} + \beta_2 \text{High-skill}_{ijt} + \beta_3 \text{High-Skill*Techgap}_{ijt} + \\ & \beta_4 \text{ICT-Cap}_{ijt} + \beta_5 \text{ICT-Cap*Techgap}_{ijt} + \beta_6 \text{Trade}_{ijt} + \\ & \beta_7 \text{Trade*Techgap}_{ijt} + \gamma_i + \delta_j + \theta_t + \varepsilon_{ijt} \end{aligned} \qquad (4.1)$$

where all variables are given in ($\Delta$ ln) growth terms. $\text{TFP}_{ijt}$ denotes Total Factor Productivity growth in country *i*, in services sector *j*, in year *t*. A convergence gap (Techgap) variable is included in the regression following standard practice in growth literature. This variables controls for the fact that services sector further away from the technology frontier exhibit higher TFP growth as part of their catching up process. Both production factors high-skilled labor and ICT capital are also included as shares of total labor and capital respectively, and interacted with the technology gap. However, these variables are not of interest since these results have already been presented in Inklaar *et al*. (2008).

The key-parameters of interest are $\beta_6$ and $\beta_7$ , which represent respectively the direct effect of services trade on TFP growth and whether this effect on TFP growth is larger for industries that are more distant (positive sign) or less distant (negative sign) from the technology frontier. Trade is estimated by four different types of services trade: 1) FDI inward stock and 2) flows that measure trade in mode 3 (commercial presence); 3) services imports that measure trade that takes place in both mode 1 and 2; and 4) sales of foreign affiliates by way of FATS statistics that forms a better measure for FDI but is rather limited in observations. All trade indicators are taken from the OECD.Stat. In the regression the trade indicators are taken separately and together.

Furthermore, $\theta_t$ is the time fixed effects since we deal with panel data for 15 years, plus $\gamma_i$ and $\delta_j$ are the fixed effects for both country and sector respectively. These last two fixed effects control for unobserved country and sector heterogeneity which may be correlated with one of the services trade indicators over time.

## 4.2 Data Description and Specification

Sectoral TFP data is taken from the EUKlems database.[20] TFP is adjusted for the share of high-skill, mid-skilled and low-skilled labor and the amount of ICT services and intermediate input use, which is a so-called "sophisticated" type of TFP instead of a more crude measure. This is important as countries differ in their input use. TFP data in the EUKlems database is constructed on a value-added basis and output basis. Value added does only measure intermediate input use and might miss some of the features of the structure of commodity or services output (Nordhaus, 2006). Accordingly, this article uses output-based TFP.

All trade data is taken from the OECD database although both FDI inward stock data as well as inflows have been collected from the UNCTAD database. Yet, the OECD gives more observations and in greater detail. The countries for which we have services trade matches perfectly with the countries for which we have TFP data. Trade is collected for the period 1990-2005, [21] except FATS which starts from 1995. Depending on the sectors, some data is missing for earlier years, but become better after 1993 for all four trade variables – especially for FATS. (See variable table for further details).[22]

Table 3 to 8 in appendix B present growth data of the services trade variables in general and per sector. What immediately stand out in Table 3 is the high number of observations for services imports, although the mean growth rate is rather modest. Other trade variables reveal a higher mean growth rate, but the number of observations for especially FATS is low. The mean statistic for FDI inward stock reflects the variables measure of accumulated investments whilst FDI inflows measures yearly investment.[23] A few elements stand out for the individual trade variables.

### *FDI Inward Stock*

The standard error for FDI inward stock in Business and Renting seems too high, which may largely be due to Denmark's extreme high inward stock in the period 1991-1998. The reason for this high number is unknown. The mean growth rate of FDI inward stock for construction and Tourism are fairly low, which may be explained by the fact that countries only started to collect services trade data after liberalizing monopoly markets halfway the 1990s.

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20 See annex for main explanations on the EUKlems database and its sector level specification.

21 Except for Czech Republic, Portugal, Slovenia and Ireland which shows data from 1995; Sweden which shows data from 1993; and Luxembourg which shows data from 1992.

22 OECD data does not clearly distinguish between the service sectors Public Administration, Health and Education. Trade data of Government services in the database is used for all three sectors, which might seem not in line with the TFP data for each personal sector and could perhaps give biased results. However, trade observations on these sectors are rather limited and this problem will be resolved in the robustness checks.

23 FDI inflows can often take on a negative value, as shown in Table 3, in which case no investments take place and instead more money is transferred back to other countries. This phenomenon volatility is reflected in the low mean statistics and wider standard deviation.

***Services Imports***

For some services sectors such as Gas, Electricity and Water, and Real Estate, the OECD does not report any data. The most important sectors which report high trade flows (not reported here) are Tourism, Transport, and Business and Renting. Construction, Communication and Community, Social and Personal services report unsurprisingly low value of trade. The mean growth rate in Communications is however significantly higher than in other services.

***FATS Statistics***

A strong anomaly in the FATS data is in the Distribution sector. Data investigation reveal that Japan's wholesale trade, as opposed to retail trade and repair of personal goods sector, shows substantial high values in USD, but it remains unclear what lies behind this data. Generally, the trade values for FATS are much higher than for FDI inward stock suggesting that FATS are a much better proxy for services trade in Mode 3 than FDI inward stock. The mean growth figures in Table 7 are well balanced, but the number of observations remains very low.

***FDI Inflows***

FDI inflows show similar amount of observations as for FDI inward stock, but the standard errors are much higher reflecting the high volatility in this type of trade. Tourism shows a negative mean growth rate which probably indicates that other modes of trade are more important (e.g. Mode 2) for this sector. In terms of mean growth rate, Transport Storage and Communication show high figures. They also show high mean FDI inflow values, but mainly caused by Communications.

## 4.3 Estimation Results Baseline Regression

The results of the baseline regression in equation (4.1) are presented in Table 9. The main focus here are the trade variables. Surprisingly, most coefficients are insignificant except for FDI inflows which is somewhat negative. The results furthermore show that both FDI inward stock and services imports also have a negative sign – only FATS remain positive. However, the interaction terms of trade and the technology gap suggests that the negative effect would mainly be felt to industries that are lying behind those industries which are closer to the technology frontier. Interesting here is that FATS has a reversed pattern showing that trade becomes more important when industries that are closer to the technology frontier.

One difficulty when regressing the effect of trade on productivity is endogeneity. A reversed causality for FDI is expected in so far foreign firms only invest internationally in those countries that already perform better. There is also substantial evidence that more productive firms are more likely

to become importers. This is not only true for goods sectors (Bernard, Jensen, Redding and Schott, 2007), but also for services. Services importers are more productive and are more likely to experience foreign ownership or be part of a foreign multinational firm (Breinlich and Criscuolo, 2009). To correct for endogeneity I apply a two-year lag on all trade variables in Table 10. However, the results do not change substantially except for services imports which now have the expected positive sign.

On the other hand, there is a positive direct of FDI inward stock in column 5 of Table 10 when all trade variables are taken together. By dong this the R-squared increases considerably. These results remain constant when applying cluster robustness checks by country, sector and year and even under a stricter form of endogeneity by applying country-sector pair fixed effects. However, doing this will also take away substantial variation in the data. Therefore I stick to country, sector and year fixed effects.[24]

## 5 Entry Barriers and Regulation "behind the border"

More often than in goods sectors, services sectors are to a large extent affected by national regulation whether on a discriminatory or non-discriminatory basis. This prevents foreign suppliers not only from entering domestic services markets, but may also defer foreign suppliers from undertaking any further investment activities once established in the market, i.e. so-called regulation behind the border. Regulation appears in many forms that are not always trade-related but cover economy-wide factors such as involvement in business operations (state-control) or administrative burdens on entrepreneurship as opposed to explicit barriers to trade an investment.

In literature regulation is often linked to the quantity of trade so that more regulation in services creates higher fixed or variable costs inhibiting exports or imports. Regulation is often proxied by taking economy-wide regulation covering all sectors which then shows a negative relationship on the volume on service trade. Frequently, this is done with in a gravity-type of framework (e.g. Francois, Fillat-Castejón and Woerz, 2008; Nicoletti *et al*., 2003a and 2003b; and Kox and Lejour, 2005). However, Kox and Nordas (2007) is a good example where sector-specific regulation has an effect on services trade, but only in finance.[25]

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[24] All regressions are also performed under country-sector pair fixed effect, plus taking the lag of two years on all trade variables. However, the main conclusions do not change, also when the regulatory variables are put into the regression. Results can be obtained from author.

[25] However, as the authors state their results rather explain the correlations between regulation and trade instead of a clear causal effect between the two variables. Furthermore, Schwellnus (2007) analysis and criticizes these studies and more that deal with the causal link between PMR and trade (exports) in greater detail. An important critique here is that this causal link may be endogenous because of political economy pressures that push for further lower regulatory barriers as a result of initial export increase thanks to technological progress that made services trade possible in the first place. I avoid such issue by (i) having both trade and regulation as independent variables; and by (ii) using imports trade so that any political economy pressure from domestic industries which might lower trade has a direct effect of lowering imports and thus lower productivity; and (iii) by using the simple lag of each regulatory variable to avoid further problems of endogeneity, as will be explained later in the text.

The effect of sectoral regulation on MFP growth has initially been analyzed by Inklaar, Timmer and van Ark (2008). The authors use but one indicator of the national market regulation database for services (NMR), – namely entry-barriers – developed by Conway and Nicoletti (2006). What they find it that such entry barriers are only somewhat significant in post and telecommunications under the assumption that all countries in their sample are similar in regard to openness to foreign competition.[26] This article goes a step further by way of including a full set of regulatory barriers based on the NMR restrictions targeted for mode 3 trade developed by Golub (2003 and 2009).

This first set of regulatory barriers that I include in the regressions are both entry barriers and what I call conduct regulation. Conduct regulation represents all types of regulation measures that takes place "behind the border" as opposed to regulation "at the border". Examples of such conduct regulation include for example price controls in the retail services sector or public ownership in the electricity sector. It represents rules and regulation that a firm faces once established in the market. Other examples of regulation that takes place behind the border in professional services are given in the variable table.[27]

Based on estimation equation (4.1) the following econometric specification can be estimated:

$$\begin{aligned} \text{TFP}_{ijt} = \quad & \alpha + \beta_1 \text{Techgap}_{ijt} + \beta_2 \text{High-skill}_{ijt} + \beta_3 \text{High-Skill*Techgap}_{ijt} + \\ & \beta_4 \text{ICT-Cap}_{ijt} + \beta_5 \text{ICT-Cap*Techgap}_{ijt} + \beta_6 \text{Trade}_{-2\ ijt} + \\ & \beta_7 \text{Trade*Techgap}_{-2\ ijt} + \beta_8 \text{Entreg}_{-2\ ijt} + \beta_9 \text{Entreg*Techgap}_{-2\ ijt} + \\ & \beta_{10} \text{Conreg}_{-2\ ijt} + \beta_{11} \text{Conreg*Techgap}_{-2\ ijt} + \gamma_i + \delta_j + \theta_t + \varepsilon_{ijt} \end{aligned} \tag{5.2}$$

where again all variables are given in ($\Delta$ ln) growth terms. All regulatory variables are interacted with the technology gap. $\text{Trade}_{-2\ ijt}$ now stands for each of the four indicators of services trade with a two years lag. $\text{Entreg}_{-2\ ijt}$ and $\text{Conreg}_{-2\ ijt}$ denote entry and conduct regulation respectively also with a two year lag in sector $j$ in country $i$ in year $t$. The usual country ($\gamma_i$), sector ($\delta_j$) and year ($\theta_t$) fixed effects apply.

The results are presented in Table 11. The variables conduct regulation for FDI inward stock and flows is highly significant with the expected signs: a one-percent point growth in regulation behind

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[26] This means that the authors did not include trade as a separate variable preventing to ask the question analyzed in this paper if trade itself becomes a determinant for TFP.

[27] Although the name of "conduct" regulation is originally only used in professional services by Conway and Nicoletti (2006), the authors also analyse other sector-specific regulation next to entry regulation for other services sectors such as retail and network services. For convenience purposes all these type of regulation for all sectors other than entry regulation is called "conduct" regulation. See footnote 6 and 7 of Table 2 for further details.

the border decreases TFP growth by 0.12 per cent inward stock. This effect is more pronounced for industries lying further away from the technology frontier, which would decrease TFP growth by 0.14 per cent. Furthermore, cluster robustness by country and sector reveal that also for FATS conduct regulation becomes greatly significant with the expected signs. (Output for these cluster robustness check are omitted, but their significance is grey-shaded in Table 11 and subsequent regression tables). Clustering further reveals that entry barriers only become significant for services imports. (Also grey shaded in Table 11 and subsequent regression tables).

### 5.1 Lowering Mode 3 Regulation that Matters at the Technology Frontier

Other types of regulation that specifically target mode 3 trade, i.e. FDI investments are not measured by entry and conduct regulation. These discriminative restrictions are developed by Golub (2009)[28] which are complementary in this study: they measure e.g. restrictions on percentage of foreign ownership, screening and approval procedures and various operational restriction in the form of nationality requirements for workers and board members or limitations on duration of work permits for expatriates. Importantly, according to Golub (2009) "barriers on labor and production markets and other barriers to entry" are not considered in this index, which in effect should be covered by entry and conduct regulation in the regression before.[29]

When estimating the effects of FDI restrictions in connection with each type of services trade – complementary to the information captured by entry and conduct regulation – I accordingly develop the following extended equation:

$$\begin{aligned} \text{TFP}_{ijt} = \quad & \alpha + \beta_1 \text{Techgap}_{ijt} + \beta_2 \text{High-skill}_{ijt} + \beta_3 \text{High-Skill*Techgap}_{ijt} + \\ & \beta_4 \text{ICT-Cap}_{ijt} + \beta_5 \text{ICT-Cap*Techgap}_{ijt} + \beta_6 \text{Trade}_{-2\ ijt} + \\ & \beta_7 \text{Trade*Techgap}_{-2\ ijt} + \beta_8 \text{Entreg}_{-2\ ijt} + \beta_9 \text{Entreg*Techgap}_{-2\ ijt} + \\ & \beta_{10} \text{Conreg}_{-2\ ijt} + \beta_{11} \text{Conreg*Techgap}_{-2\ ijt} + \beta_{12} \text{FDIRest}_{-2\ ijt} + \\ & \beta_{13} \text{FDIRest*Techgap}_{-2\ ijt} + \gamma_i + \delta_j + \theta_t + \varepsilon_{ijt} \end{aligned} \tag{5.3}$$

where again all variables are measures in ($\Delta$ ln) growth terms, plus the lag for all trade and regulation variables to avoid endogeneity. Again, usual country ($\gamma_i$), sector ($\delta_j$) and year ($\theta_t$) fixed effects apply.

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[28] The author greatly acknowledges his support for sharing the data.

[29] Examples that Golub (2009) gives on what is not included are domestic content requirements, price ceilings and prudential regulation. Exactly topics that partly included in the variable conduct regulation.

The results for adding the FDI restrictions into the equation are presented in Table 12 in the appendix. What stands out straight away is that the signs for FDI restrictions are reversed and (weakly) significant. This suggests that the increase of FDI restrictions would increase TFP growth. This may be in line with findings by e.g. Aitken and Harrison (1999) or Harrison and Rodríguez-Clare (2009) that suggest that FDI has an insignificant or negative affect on TFP growth as horizontal spill-overs from FDI investors do not take place in the domestic economy.[30] Instead, a foreign firm that invests with inward FDI stock would, according to the authors, take over a domestic market share that drives up the cost curve in sectors with economy of scale. Hence, increasing restrictions to limit inward FDI may give an initial productivity increase.

Typically these studies, and the studies mentioned in footnote 30, include emerging or transition economies that are placed further away from the technology frontier. The interaction terms in (5.3) suggest that the direct effect of $\beta_{12}$ FDIRest $_{-2\ ijt}$ is indeed negative when $\beta_1$ Techgap $_{ijt}$ is zero, i.e. for countries where the technology gap does not close and, thus, technology improvement does not take place. Therefore looking at what happens when the technology gap closes would reveal more interesting information of the effect of FDI restrictions on TFP growth. This is demonstrated in Table 13 in the appendix. The coefficients for $\beta_{12}$ FDIRest $_{-2\ ijt}$ (FDI restrictions) of equation (5.3) are taken to see the marginal effect starting at when the technology gap is 0 and, consequently, every time the technology gap closes by 0.1. The third column illustrates whether this marginal effect for FDI restrictions in each regression is significant.[31]

The results confirm that although countries that still need to catch up with their technology, raising FDI restriction has only a temporary effect on their TFP growth. What essentially counts is that when countries move up to the technology frontier FDI restrictions become a significant negative determinant for TFP growth. This result remains significant even when performing robustness checks by way of clustering effects.

## 5.2 The Effect of Mode 3 restrictions in High-Skilled Service Sectors

A negative link between higher FDI regulation and TFP growth, present in services industries that are situated closer to the technology frontier, may suggest that such restrictions have a profound effect for services sectors that have experienced growth increase in their high-skilled labor share. This effect would come as no surprise as foreign investments may bring along new concepts of doing business that typically needs high-skilled labor to be developed or implemented. FDI restriction that include measures that prohibit or limit such free movement of skills could therefore have a more

[30] Other studies that Harrison and Rodríguez-Clare (2009) mention are Djankov and Hoekman (2000) for the Czech Republic, Smarzynska (2002) for Lithuania, Lopez-Cordova (2003) for Mexico, Damijan et al (2001) for eight transition economies, Kathuria (2000) for India, Hu and Je¤erson (2002) and others.

[31] As done in growth literature and applied in all other regressions of this paper, the US as a benchmark is set at 1.

detrimental effect on TFP growth. Consequently, interacting FDI regulation with the growth share of high-skilled labor in services sectors should have interesting results when including such interaction effect in the regression equation (5.3).

Table 14 confirms such expectation to a very significant level for both FDI inward stock and FATS statistics suggesting that these restrictions of FDI match trade in mode 3 quite well. Both coefficients are greatly negative implying that an additional increase in FDI restrictions yields a lower TFP growth for services sectors that have experienced growth in their shares of high-skilled labor. It substantiates the thought that FDI brings along spill-over effects that are much associated with high-skilled labor. This is especially true for services industries approaching the technology frontier as the interaction variable with the technology gap is significantly negative. Again, the fact that FDI restriction initially explain increasing TFP growth for services industries further away from the technology frontier is summarized in Table 15 in the appendix. However, this effect here is once again only temporarily.

Other interaction with growth shares of high-skilled labor for entry and conduct regulation do not become significant for services imports. However, a similar negative result for entry barriers interacted with high-skilled labor is found for FATS type of trade. Also here the negative and significant coefficient for the interacting technology variable suggest that entry barriers are especially a determinant for lower TFP growth when industries are closer to the technology frontier. Conduct regulation in combination with high-skilled stays insignificant for all types of trade. This is not surprising as this type or regulation would target other measures that is not specifically related to a certain level of labor skills.

The results are very robust when clustered by country, sector and year. These robustness checks also mark entry barriers in combination with services imports as an important determinant for TFP growth (with the expected coefficient signs grey-shaded in the table). Furthermore, an extra robustness check is included in Table 16 where only Business services sectors are included.

### 5.3 Policy Implications for Personal Services Sectors: Health a non-Tradable?

Although personal services sector output are hard to measure and therefore figures on TFP in these services should be taken with care, a reasonable assumption from data suggest that personal services have lower TFP growth than other market services. Whether this eventually causes lower economic growth as the Baumol theory predicts is a long-term question. Nevertheless, to ask how productivity in these sectors can be increased is a legitimate question. For it is a well-recognized fact that especially in the health care sector prices and expenditures are continuing growing at a fast rate.

The results of the econometric works widely advocate that regulation is largely responsible for the varying TFP growth figures in services sectors among countries. Especially regulation which is tied to FDI and FATS (mode 3 trade), in combination with a growing share of high-skilled labor in services sectors, suggests important policy implications. Personal services sectors such as health care and education exhibit large shares of high-skilled labor as shown in Table 16 – around 26 and 47 per cent respectively. These figures are comparable with some other market services, such as finance or business and renting. High levels of regulation in this mode, next to other types of regulation is the significant explanatory variable for TFP growth rates to differ among countries.

It's important to emphasize that lowering regulation would not only increase TFP growth as a consequence of merely importing competition. Typically, as FDI regulation seems to be the main driver of shaping productivity (and not trade), it would suggest that participation of foreign skills that bring along spill-over effects together with innovative work procedures and skills, organizational novelties and "logistics" improvements would improve TFP growth. FDI regulation included in this paper covers restrictions on foreign participation from third parties. This would therefore have a greater effect on sectors with higher shares of high-skilled labor. To date and within the GATS framework, health and education are one of the most heavily regulated service sectors.

Lowering regulation by way of increasing shares of mode 3 trade so as to increase TFP growth in the health sector is different than trade through another type of mode 2 that gradually takes place in the health sector. Health care trade through mode 2 takes place when patients move to low-income countries that experience a cost-advantage in performing often standardized (labor) intensive health services. However, introducing trade by lowering FDI restrictions in high-skilled sectors predicts that high-income economies are most likely to become trading partners as their health-care sectors are closer to the technology frontier. Specializing according to each country's comparative advantage might then bring along horizontal specialization to increase productivity.

## 6 Conclusion

This paper has asked the empirical question whether trade or trade-related regulation – corrected for factor accumulation – determines services TFP growth. Surprisingly, this paper does not find any significant indications for services trade to be a positive determinant on TFP growth. The main reason may be that such services trade is to a large extent inhibited by regulation. In the regressions of this paper, regulation that is strongly targeted at services trade has shown to be a powerful and significant variable that is negatively associated with services TFP growth.

However, another important result of this paper is that different types of regulation covers different measures of trade restrictions, which in turn has different effects through different forms of

services trade. Entry regulation is largely negatively significant on TFP growth in connection with services imports through mode 1 and 2. Regulation "behind the border" is a significant negative determinant in relation with mainly FDI inward stock and FATS statistics, which represents trade through mode 3 – foreign establishment. As such, these variables measure the inhibiting nature of regulation on services MFP growth quite well.

Furthermore, I find that the effect of entry barriers and conduct regulation is more pronounced for services sectors that are more distant from the technology frontier. One possible reason for this is that countries that have service sector closer to the technology frontier are usually already well integrated and further TFP growth in these sectors through services trade then becomes to depend on other forms of regulation. In relation to this last statement, FDI restrictions that target mode 3 trade seem to have a larger effect for services sectors that are closer to the technology frontier – most likely because spill-over effects from high-skilled labor would be hindered to create higher TFP growth.

This last explanatory factor of diverging TFP growth among countries becomes specifically visible when FDI restrictions are interacted with the growth share of high-skilled labor in services. This means that FDI trade contains specific factors such as spill-over effects that target productivity improvements through introducing new concepts and work procedures developed by the higher-skilled or just simply through the movement of high-skilled labor. It would suggest that such effect would be more pronounced in sectors that require a bigger share of high-skilled labor and are relatively close to the technology frontier. Examples of the latter are some business sectors, but also the health sectors and education.

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## Appendix A: Data Sources

EUKlems Database

The EUKlems database covers 28 countries of which most of them are OECD countries. Depending on the variable, the data series spans a wide time period from roughly 1970 for mainly Western European countries, Korea and Japan and from the 1990s from non-Western European countries.[32] In this database information is given for totally 107 categories of industries of which 37 categories form head categories on a 2-digit level of which one is a 1-digit level for total industries. The coverage for services counts 45 sectors in which both 3- and 2-digit category levels are included. Within the business services category 12 out of totally 32 represent head categories on a 2-digit level. The personal services category have in total 7 head categories on 2-digit level of which two services sector are practically no data given.[33] No data for 3-digit services sectors are given.

Multi Factor Productivity (EUKlems)

Sectoral TFP as calculated by Timmer, O'Mahony and Ark (2008). This TFP measure is calculated by subtracting the (cost-share weighted) share in hours worked by different types of workers, different types of capital and intermediate inputs from share of gross output at constant prices. Although the EUKlems database shows output-based TFP data on both 3-digit and 2-digit sector level,d ata on 2-digit level is rather scarce. Where TFP data on this level is missing, a weighted TFP is calculated based on nominal output. This TFP data can then be matched with the trade data. Acquiring information on both digits levels will turn out to be convenient as for some countries trade data is only available on a 2-digit level, as shown in the variable table. Data is collected for the time period 1990-2005. The 3-digit sectors include: (a) Transport, Storage and Communication, (b) Finance, Insurance and Real Estate and Business Services, (c) Real Estate, Renting and Business Services. Moreover, depending on the trade variables, not all sector are included as data is not always given.

Technology gap (Inklaar, Timmer and van Ark, 2008)

Calculations are made following the methodology outlined by Inklaar, Timmer and van Ark (2008) based on the TFP data described above. The authors measure technology gap as TFP gaps even though TFP measures also reflect other factors besides technology. The relative MFP levels corrected for price differences between countries are used in this variable. The US is used as a benchmark and therefore represents the technology frontier. Explanations about this variable and additional papers on this subject can be found at http://ggdc.net/databases/levels.htm

[32] Exceptions are Ireland and Portugal which show data only from the 1990s for some variables.

[33] These two personal services categories are Private households with employed persons and Extra-territorial organizations and bodies.

FDI Inward Stock / Inward Flows (OECD)

Inward FDI position, industry sector based ISIC3 (and NACE). A direct investment enterprise is defined as an incorporated or unincorporated enterprise in which a foreign investor owns 10 per cent or more of the ordinary shares or voting power of an incorporated enterprise or the equivalent of an unincorporated enterprise. The numerical guideline of ownership of 10 per cent of ordinary shares or voting stock determines the existence of a direct investment relationship. An effective voice in the management, as evidenced by an ownership of at least 10 per cent, implies that the direct investor is able to influence or participate in the management of an enterprise; it does not require absolute control by the foreign investor.

Services Imports (OECD)

OECD Statistics on International Trade in Services: Volume I: Detailed Tables by Service Category. The types of services are presented according to the services classification of the 1993 Fifth edition of the Balance of Payments Manual of the International Monetary Fund (BPM5) and its detailed extension, the Extended Balance of Payments Services (EBOPS) Classification. Data are submitted directly to the OECD by the non-EU OECD member countries and are published without any further changes.

FATS (OECD)

FATS Statistics Sales (turnover) for inward activity of the OECD Inward activity of Multinationals in ISIC Rev 3 (services). No further meta data is given is the OECDStat.

Entry regulation (OECD)

Data is part of PMR and are on discrete basis but are also intrapolated to make them continues. Head categories (sector) are unweighted averages. Real Est. Rent. Business; Real Estate & Business and Renting similar PMRs. They include Licensing, Educational Requirements, Quotas and Economic needs test for Professional services; Registration in commercial register, Licenses or permits needed to engage in commercial activity and Specific regulation of large outlets for Distribution services; and sector specific entry barriers for Transport and Communication services. Slovenia is not included. Head categories of services sector as unweighted averages. Index is rescaled from 0 to 1.

Conduct regulation (OECD)

Data is part of PMR and are on discrete basis but are also intrapolated to make them continuous. Head categories (sector) are unweighted averages. Real Est. Rent. Business; Real Estate & Business and Renting similar PMRs. They include Regulation on prices and fees, Regulation on Advertising and Regulation on forms of business and inter-professional cooperation for Professional services; Operational restrictions (protection of existing firms and regulation concerning opening hours) and Price controls for Distribution; and Public ownership, Market structure, Vertical integration and Price controls for Transport and Communication services. Slovenia not included. Head categories of services sector as unweighted averages. Index is rescaled from 0 to 1.

FDI restrictions (Golub, 2009)

Data is provided by Stephen Golub and explained in Golub (2009). Initially the FDI restrictiveness indicator has also been used for the PMR as sector specific variables as part of Barriers to Trade and Investments. The FDI restriction scoring method include measures on the broad categories, namely (a) foreign ownership (foreign equity allowance), (b) screening and approval procedures and (c) operational restrictions such as national or residential requirements for board of director/ managers, duration of work permits for expatriates and other restrictions. Services industries and their subsectors are weighted by their FDI instead of GDP. However, an average of FDI and trade weights has been employed using OECD data taken from Golub (2003) to mitigate endogeneity issues. Index ranges from 0 to 1.

## Appendix B: Tables and Figures

Figure 1: Total Factor Productivity (TFP) levels developments for 1990-2005

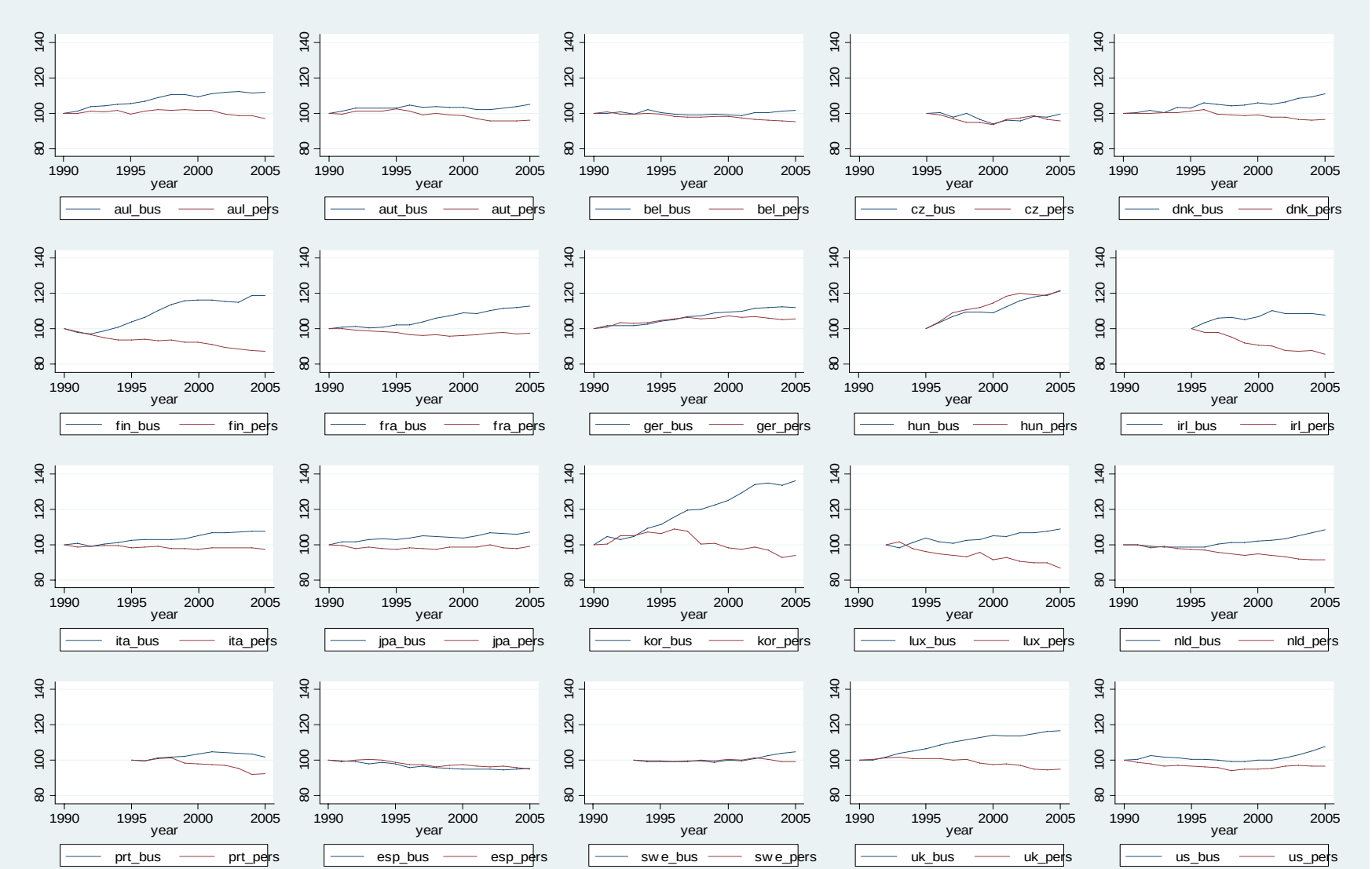

Table 2: Variable table

| | TFP level (output) | FDI Inflow OECD source | FDI Instock OECD source | Services Import OECD source | FATS OECD source | PMR (Discr. & Cont) | Entry Regulation (Discr. & Cont) | Conduct Regulation (Discr & Cont.) | FDI Restrictions (Discr. & Cont.) |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (2) | (3) | (4) | (5) | (6) | (7) | (10) |
| Electr Gas Water | 1990-2005 | 1993-2005 | 1993-2005 | - | 1995-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1991-2005 |
| Construction | 1990-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1995-2005 | - | - | - | 1991-2005 |
| Distribution | 1990-2005 | 1990-2005 | 1990-2005 | - | 1995-2005 | 1996-2005 | 1996-2005 | 1996-2005 | 1991-2005 |
| Tourism | 1990-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1995-2005 | - | - | - | 1991-2005 |
| Transp Stor Com | 1990-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1995-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1991-2005 |
| Transp | 1990-2005 | 1999-2005 | 1999-2005 | 1990-2005 | 1995-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1991-2005 |
| Communications | 1990-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1995-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1991-2005 |
| Fin Ins Real Bus | 1990-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1995-2005 | - | - | - | 1991-2005 |
| Finance | 1990-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1995-2005 | - | - | - | 1991-2005 |
| Real Est. Rent. Business | 1990-2005 | 1993-2005 | 1993-2005 | - | 1995-2005 | 1996-2005 | 1996-2005 | 1996-2005 | 1991-2005 |
| Real Estate | 1990-2005 | 1993-2005 | 1993-2005 | - | 1995-2005 | 1996-2005 | 1996-2005 | 1996-2005 | 1991-2005 |
| Business & Renting | 1990-2005 | 1993-2005 | 1993-2005 | 1990-2005 | 1995-2005 | 1996-2005 | 1996-2005 | 1996-2005 | 1991-2005 |
| Com Soc Perso | 1990-2005 | 1990-2005 | 1990-2005 | 1990-2005 | 1995-2005 | - | - | - | - |
| Publ Adm | 1990-2005 | - | - | 1990-2005 | - | - | - | - | - |
| Education | 1990-2005 | - | - | 1990-2005 | - | - | - | - | - |
| Health | 1990-2005 | - | - | 1990-2005 | - | - | - | - | - |
| Other Personal services | 1990-2005 | - | - | - | 1995-2005 | - | - | - | - |
| No of countries included* | 21 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 |
| Variable specifics | Index | Normal | Normal | Normal | Normal | Index (0-6) | Index (0-6) | Index (0-6) | Index (0-1) |

(1) Data available from 1980 onwards for most countries, except CZ, PRT, SVN IRL, HUN from 1995; SWE from 1993; LUX from 1992. Head categories of services sector as weighted averages by their nominal output. Source: EUKlems

(2) Many zero trade flows in early 1990s but from 1993 better for Electr. Gas Water; Toerism; Real Est. Rent. Business; Real Estate; Poor data for Transport. Actual data continues to 2006/2007.

(3) Many zero trade flows in early 1990s but from 1993 better for Communications. Public Adm. And, Health and Education idem data. Actual data continues to 2006/2007.

(4) Only from 1995 onwards available. Quite some countries missing in data.

(5) PMRs are on discrete basis but are also intrapolated to make them continues. Head categories (sector) are unweighted averages. Real Est. Rent. Business; Real Estate & Business and Renting similar PMRs. Slovenia not included. Head categories of services sector as unweighted averages.

(6) Entry regulation are part of PMR and are on discrete basis but are also intrapolated to make them continues. Head categories (sector) are unweighted averages. Real Est. Rent. Business; Real Estate & Business and Renting similar PMRs. They include Licensing, Educational Requirements, Quotas and Economic needs test for Professional services; Registration in commercial register, Licenses or permits needed to engage in commercial activity and Specific regulation of large outlets for Distribution services; and sector specific entry barriers for Transport and Communication services. Slovenia excluded. Head categories of services sector as unweighted averages.

(7) Conduct regulation are part of PMR and are on discrete basis but are also intrapolated to make them continues. Head categories (sector) are unweighted averages. Real Est. Rent. Business; Real Estate & Business and Renting similar PMRs. They include Regulation on prices and fees, Regulation on Advertising and Regulation on forms of business and interprofessional cooperation for Professional services; Operational restrictions (protection of existing firms and regulation concerning opening hours) and Price controls for Distribution; and Public ownership, Market structure, Vertical integration and Price controls for Transport and Communication services. Slovenia not included. Head categories of services sector as unweighted averages.

(8) Received data from Stephen Galob and also used for UNCTAD and OECD studies. PMRs are partly based on this information. FDI regulation index is sector specific and are available from 1981 onwards! Korea, Czech Republic and Hungary only time-series from 1996 onwards. Head categories of services sector as unweighted averages.

* Countries for which data is researched. Trade data too dispersed to indicate the number of countries for which I have good data.

Table 3: Summary table of the selected variables (in Δ ln)

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| TFP (output-based) | 5083 | .0007143 | .0256652 | -.2090377 | .1829378 |
| Technology gap | 4930 | .9450209 | .2849236 | .3044278 | 3.871316 |
| High-skilled labor share | 5015 | .0282278 | .0878922 | -.7425235 | 1.12815 |
| ICT-capital share | 5049 | .0132097 | .2604589 | -4.337976 | 4.067055 |
| FDI inward stock | 1723 | .1472768 | .4967 | -5.889042 | 6.183538 |
| Services imports | 3016 | .0835928 | .3885326 | -3.970282 | 4.842437 |
| FATS sales | 910 | .1419413 | .4636052 | -4.691095 | 3.123531 |
| FDI inward flows | 1759 | .1820892 | 1.41939 | -5.779026 | 8.184199 |
| Entry barriers | 1791 | -.0672223 | .1958363 | -2.282382 | .3626719 |
| Conduct regulation | 1876 | -.0387651 | .0772732 | -.7884574 | .438255 |
| FDI restrictions | 2940 | -.0551982 | .1057739 | -1.882731 | 1.122143 |

Table 4: Correlation Matrix

| Variable | tfpgrth_out_ | tfpg_out_ | gr_hhs_ | gr_capit_ | gr_fdi_ in_st_o_ | gr_serv_ imp_o_ | gr_ fats_o_ | gr_fdi_ in_fl_o_ | gr_ent reg_c_rc_ | gr_con reg_c_rc_ | gr_fdi rest_c_ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TFP (output based) | 1.0000 | | | | | | | | | | |
| Technology gap | 0.3206 | 1.0000 | | | | | | | | | |
| High-skilled labor share | 0.0029 | -0.0689 | 1.0000 | | | | | | | | |
| ICT-capital share | -0.4512 | -0.1294 | 0.0193 | 1.0000 | | | | | | | |
| FDI inward stock | -0.0511 | -0.1196 | 0.0785 | 0.0853 | 1.0000 | | | | | | |
| Services imports | 0.1956 | 0.0685 | 0.1520 | -0.2574 | 0.1402 | 1.0000 | | | | | |
| FATS sales | -0.0251 | 0.0031 | 0.1850 | 0.1563 | 0.0227 | 0.0067 | 1.0000 | | | | |
| FDI inward flows | 0.0239 | -0.0277 | 0.0311 | 0.0811 | 0.4670 | 0.0377 | -0.1489 | 1.0000 | | | |
| Entry barriers | -0.1028 | 0.1006 | -0.0801 | -0.0692 | 0.1150 | -0.0758 | -0.0279 | -0.1416 | 1.0000 | | |
| Conduct regulation | -0.0661 | 0.0239 | 0.0187 | 0.0186 | 0.0977 | 0.2729 | 0.0702 | -0.0728 | 0.2694 | 1.0000 | |
| FDI restrictions | -0.2868 | 0.0956 | 0.0495 | -0.0552 | -0.1294 | 0.2946 | -0.0134 | -0.2227 | 0.1104 | 0.5066 | 1.0000 |

| Variable | gr_fdi_in_st_o_ | gr_serv_imp_o_ | gr_fats_o_ | gr_fdi_in_fl_o_ |
|---|---|---|---|---|
| FDI inward stock | 1.0000 | | | |
| Services imports | 0.1277 | 1.0000 | | |
| FATS sales | 0.0429 | 0.0190 | 1.0000 | |
| FDI inward flows | 0.4159 | 0.1039 | -0.0711 | 1.0000 |

| Variable | gr_entreg_c_rc_ | gr_conreg_c_rc_ | gr_fdirest_c_ |
|---|---|---|---|
| Entry barriers | 1.0000 | | |
| Conduct reg | 0.1398 | 1.0000 | |
| FDI restrictions | 0.0846 | 0.0985 | 1.0000 |

Table 5: Summary statistics for FDI Inward Stock

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Business & Rent. | 111 | .1827480 | .9063102 | -5.889042 | 5.116658 |
| Com Soc Perso | 148 | .1525682 | .892783 | -3.062838 | 6.183538 |
| Commun | 38 | .2955667 | .6363593 | -.7902336 | 2.581171 |
| Construction | 154 | .0787672 | .3953583 | -1.482259 | 1.948622 |
| Distrib | 181 | .1088689 | .2166673 | -.7421913 | 1.261327 |
| Educ | 0 | | | | |
| Electr Gas Water | 123 | .1653506 | .4863363 | -1.947483 | 1.66961 |
| Fin Ins Real Bus | 190 | .1596504 | .3431489 | -1.2633 | 1.969322 |
| Finance | 197 | .1334152 | .331972 | -1.2633 | 1.969322 |
| Health | 0 | | | | |
| Other Pers | 0 | | | | |
| Publ Adm | 0 | | | | |
| Real Est. Rent. Business | 145 | .1936760 | .2565138 | -.6778917 | 1.311818 |
| Real Estate | 111 | .1403570 | .4856517 | -3.124952 | 1.404391 |
| Tourism | 138 | .0541792 | .4604675 | -1.991862 | 2.807285 |
| Transp | 36 | .2034137 | .2747647 | -.3893375 | 1.137323 |
| Transp Stor Com | 151 | .2146295 | .4143784 | -.9421043 | 1.837228 |

Table 6: Summary statistics for Services Imports

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Business & Rent. | 255 | .1212297 | .3512857 | -.5720415 | 4.760379 |
| Com Soc Perso | 242 | .0934558 | .4418236 | -3.970282 | 2.182784 |
| Commun | 246 | .1256095 | .3518008 | -1.395508 | 1.879996 |
| Construction | 221 | .0349455 | .5263781 | -3.295903 | 1.386643 |
| Distrib | 0 | | | | |
| Educ | 253 | .0574665 | .3698302 | -.7806301 | 4.521006 |
| Electr Gas Water | 0 | | | | |
| Fin Ins Real Bus | 255 | .1136509 | .3437562 | -.700439 | 4.842437 |
| Finance | 247 | .0826065 | .3724208 | -1.466502 | 1.914896 |
| Health | 253 | .0574665 | .3698302 | -.7806301 | 4.521006 |
| Other Pers | 0 | | | | |
| Publ Adm | 253 | .0574665 | .3698302 | -.7806301 | 4.521006 |
| Real Est. Rent. Business | 15 | .0763994 | .0693781 | -.0122786 | .2417088 |
| Real Estate | 0 | | | | |
| Tourism | 266 | .0810481 | .3133226 | -.6999683 | 4.492497 |
| Transp | 253 | .0819167 | .326181 | -.6068738 | 4.776927 |
| Transp Stor Com | 257 | .0915619 | .4958011 | -3.785052 | 4.776927 |

Table 7: Summary statistics for FATS

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Business & Rent. | 69 | .1330776 | .388682 | -1.212581 | 2.134002 |
| Com Soc Perso | 70 | .1343024 | .6962608 | -3.472218 | 2.601134 |
| Commun | 56 | .2567978 | .5400673 | -1.435817 | 2.699958 |
| Construction | 68 | .0879892 | .2493449 | -.4107776 | 1.501836 |
| Distrib | 84 | .1084448 | .1566535 | -.2136707 | .8433838 |
| Educ | 26 | .0667553 | .3836826 | -.7989206 | 1.061917 |
| Electr Gas Water | 51 | .2318939 | .5965762 | -1.339866 | 3.123531 |
| Fin Ins Real Bus | 48 | .1191475 | .4820354 | -1.253403 | 2.148449 |
| Finance | 45 | .1394075 | .2808196 | -.5774021 | .8294315 |
| Health | 0 | | | | |
| Other Pers | 47 | .1223017 | .8613643 | -4.691095 | 1.426543 |
| Publ Adm | 0 | | | | |
| Real Est. Rent. Business | 72 | .1066362 | .49693 | -1.906598 | 2.83667 |
| Real Estate | 60 | .1602786 | .4142041 | -1.394153 | 1.181077 |
| Tourism | 77 | .1056251 | .2460542 | -.5212955 | 1.342676 |
| Transp | 55 | .2179383 | .5450603 | -.9585915 | 2.126571 |
| Transp Stor Com | 82 | .1511299 | .3320268 | -1.047323 | 1.202575 |

Table 8: Summary statistics for FDI inflows

| | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Business & Rent. | 123 | .2176967 | 1.257101 | -4.431576 | 4.007068 |
| Com Soc Perso | 144 | .1503893 | 1.378764 | -3.755772 | 5.545673 |
| Commun | 82 | .3230221 | 1.719161 | -3.358193 | 3.574217 |
| Construction | 143 | .1561955 | 1.557348 | -5.653074 | 6.848822 |
| Distrib | 186 | .0634414 | 1.225852 | -4.868565 | 4.861478 |
| Educ | 0 | | | | |
| Electr Gas Water | 98 | .3695075 | 2.219211 | -3.951061 | 8.184199 |
| Fin Ins Real Bus | 220 | .1413195 | 1.099108 | -4.020417 | 4.295833 |
| Finance | 203 | .1011590 | 1.454639 | -5.779026 | 4.489973 |
| Health | 0 | | | | |
| Other Pers | 0 | | | | |
| Publ Adm | 0 | | | | |
| Real Est. Rent. Business | 163 | .2372677 | 1.153038 | -4.557771 | 5.593092 |
| Real Estate | 98 | .2651849 | 1.318531 | -4.152494 | 4.020665 |
| Tourism | 114 | -.0178500 | 1.348766 | -3.905887 | 5.259189 |
| Transp | 33 | .2981839 | 1.598633 | -2.831948 | 4.067742 |
| Transp Stor Com | 152 | .3350861 | 1.532808 | -5.206096 | 5.851419 |

Table 9: Fixed effects regression (1) (Country, sector and year fixed effects) without lags for the trade variables.

| VARIABLES | (1) TFP growth | (2) TFP growth | (3) TFP growth | (4) TFP growth | (5) TFP growth |
|---|---|---|---|---|---|
| Technology gap | 0.00649* | 0.00625** | 0.00612* | 0.00565* | 0.00388 |
| | (0.00364) | (0.00296) | (0.00345) | (0.00321) | (0.00804) |
| High-skiled labor | -0.0403** | -0.0844*** | -0.0420* | -0.0316* | -0.0929* |
| | (0.0175) | (0.0220) | (0.0244) | (0.0188) | (0.0542) |
| High-skiled labor*Tech gap | 0.0260 | 0.0608*** | 0.0244 | 0.00998 | 0.0978* |
| | (0.0201) | (0.0220) | (0.0263) | (0.0201) | (0.0591) |
| ICT-capital | 0.00851 | -0.0201 | -0.0471** | 0.00644 | -0.124* |
| | (0.0130) | (0.0143) | (0.0216) | (0.0165) | (0.0675) |
| ICT-capital*Tech gap | -0.0236 | 0.00519 | 0.0102 | -0.0239 | 0.0622 |
| | (0.0176) | (0.0147) | (0.0254) | (0.0222) | (0.0711) |
| FDI inward stock | -0.00801 | | | | -0.0164 |
| | (0.00763) | | | | (0.0174) |
| FDI inward stock*Tech gap | 0.00999 | | | | 0.0144 |
| | (0.00795) | | | | (0.0200) |
| Services imports | | -0.00203 | | | 0.0165 |
| | | (0.00566) | | | (0.0287) |
| Services imports*Tech gap | | 0.00404 | | | -0.0229 |
| | | (0.00514) | | | (0.0300) |
| FATS sales | | | 0.00355 | | -0.00207 |
| | | | (0.00549) | | (0.0116) |
| FATS sales*Tech gap | | | -0.00368 | | 0.00189 |
| | | | (0.00572) | | (0.0113) |
| FDI inflows | | | | -0.00265* | |
| | | | | (0.00152) | |
| FDI inflows*Tech gap | | | | 0.00273* | |
| | | | | (0.00163) | |
| Observations | 1517 | 2656 | 910 | 1534 | 340 |
| R-squared | 0.160 | 0.176 | 0.222 | 0.167 | 0.342 |

Notes: The dependant variable is the level of TFP Definitions of Entry and Conduct regulations can be found in the footnotes 6 and 7 of Table 2. *, ** and *** denote coefficients significantly different from 0 at, respectively, the 10% ($p<0.1$), 5% ($p<0.05$) and 1% ($p<0.001$) levels. Robust White heteroscedasticity corrected standard errors are given in parenthesis. All veriables are in $\Delta$ ln. Tech gap in the interaction variables stands for the technology gap.

Table 10: Fixed effects regression (1) (Country, sector and year fixed effects) with 2-years lag for the trade variables.

| VARIABLES | (1) TFP growth | (2) TFP growth | (3) TFP growth | (4) TFP growth | (5) TFP growth |
|---|---|---|---|---|---|
| Technology gap | 0.00846** | 0.00831*** | 0.00144 | 0.00703** | 0.0310*** |
| | (0.00407) | (0.00321) | (0.00426) | (0.00316) | (0.0102) |
| High-skiled labor | -0.0578*** | -0.0813*** | -0.0392 | -0.0426** | -0.113* |
| | (0.0204) | (0.0250) | (0.0292) | (0.0185) | (0.0611) |
| High-skiled labor*Tech gap | 0.0505** | 0.0571** | 0.0308 | 0.0351* | 0.121* |
| | (0.0240) | (0.0251) | (0.0349) | (0.0204) | (0.0667) |
| ICT-capital | 0.0127 | -0.0229 | -0.0228 | 0.00327 | -0.108* |
| | (0.0146) | (0.0153) | (0.0311) | (0.0137) | (0.0615) |
| ICT-capital*Tech gap | -0.0282 | 0.00857 | -0.0105 | -0.0169 | 0.0424 |
| | (0.0203) | (0.0156) | (0.0391) | (0.0184) | (0.0677) |
| FDI inward stock | -0.000496 | | | | 0.0270* |
| | (0.00610) | | | | (0.0153) |
| FDI inward stock*Tech gap | 0.000426 | | | | -0.0309* |
| | (0.00710) | | | | (0.0178) |
| Services imports | | 0.00774 | | | -0.0265 |
| | | (0.00560) | | | (0.0340) |
| Services imports*Tech gap | | -0.00822 | | | 0.0362 |
| | | (0.00537) | | | (0.0345) |
| FATS sales | | | 0.00127 | | -0.00724 |
| | | | (0.00646) | | (0.00949) |
| FATS sales*Tech gap | | | -0.00155 | | 0.00835 |
| | | | (0.00749) | | (0.00999) |
| FDI inflows | | | | -0.00107 | |
| | | | | (0.00160) | |
| FDI inflows*Tech gap | | | | 0.000799 | |
| | | | | (0.00164) | |
| Observations | 1254 | 2307 | 654 | 1365 | 252 |
| R-squared | 0.153 | 0.174 | 0.233 | 0.142 | 0.342 |

Notes: The dependant variable is the level of TFP Definitions of Entry and Conduct regulations can be found in the footnotes 6 and 7 of Table 2. *, ** and *** denote coefficients significantly different from 0 at, respectively, the 10% ($p<0.1$), 5% ($p<0.05$) and 1% ($p<0.001$) levels. Robust White heteroscedasticity corrected standard errors are given in parenthesis. All veriables are in $\Delta$ ln. Tech gap in the interaction variables stands for the technology gap.

Table 11: Fixed effects regression (2) (Country, sector and year fixed effects) with 2-years lag for the trade and regulation variables.

| VARIABLES | (1) TFP growth | (2) TFP growth | (3) TFP growth | (4) TFP growth | (5) TFP growth |
|---|---|---|---|---|---|
| Technology gap | 0.00999 | 0.0120* | 0.00149 | 0.0145** | 0.0120 |
| | (0.00634) | (0.00685) | (0.00521) | (0.00683) | (0.0314) |
| High-skiled labor | -0.0341 | -0.128*** | -0.0277 | -0.0316* | 0.0251 |
| | (0.0224) | (0.0396) | (0.0419) | (0.0186) | (0.0931) |
| High-skiled labor*Tech gap | 0.0260 | 0.105*** | 0.0108 | 0.0317 | -0.0694 |
| | (0.0256) | (0.0398) | (0.0514) | (0.0216) | (0.106) |
| ICT-capital | 0.0199 | 0.0211 | -0.00701 | 0.0377** | -0.0484 |
| | (0.0196) | (0.0293) | (0.0374) | (0.0175) | (0.142) |
| ICT-capital*Tech gap | -0.0355 | -0.0492 | -0.0241 | -0.0634** | -0.0532 |
| | (0.0301) | (0.0371) | (0.0413) | (0.0264) | (0.148) |
| FDI inward stock | 0.00199 | | | | 0.0253 |
| | (0.00757) | | | | (0.0261) |
| FDI inward stock*Tech gap | -0.00316 | | | | -0.0275 |
| | (0.00907) | | | | (0.0296) |
| Services imports | | -0.00253 | | | -0.0321 |
| | | (0.00805) | | | (0.109) |
| Services imports*Tech gap | | -0.00193 | | | 0.0424 |
| | | (0.00976) | | | (0.117) |
| FATS sales | | | -0.00159 | | 0.0150 |
| | | | (0.00604) | | (0.0213) |
| FATS sales*Tech gap | | | 0.00331 | | -0.00483 |
| | | | (0.00659) | | (0.0174) |
| FDI inflows | | | | -0.000497 | |
| | | | | (0.00303) | |
| FDI inflows*Tech gap | | | | 0.000308 | |
| | | | | (0.00322) | |
| Entry barriers | 0.00554 | -0.0263 | 0.0113 | -0.0107 | 0.0967 |
| | (0.0233) | (0.0164) | (0.0208) | (0.0159) | (0.0852) |
| Entry barriers*Tech gap | 0.00185 | 0.0206 | -0.0192 | 0.0160 | -0.105 |
| | (0.0242) | (0.0161) | (0.0183) | (0.0167) | (0.0926) |
| Conduct regulation | -0.118** | -0.000799 | -0.115 | -0.0826* | -0.165 |
| | (0.0468) | (0.0456) | (0.0774) | (0.0473) | (0.252) |
| Conduct regulation*Tech gap | 0.142*** | -0.00838 | 0.124 | 0.0689 | 0.196 |
| | (0.0533) | (0.0477) | (0.0838) | (0.0517) | (0.233) |
| Observations | 455 | 664 | 335 | 532 | 78 |
| R-squared | 0.279 | 0.286 | 0.324 | 0.251 | 0.538 |

Notes: The dependant variable is the level of TFP Definitions of Entry and Conduct regulations can be found in the footnotes 6 and 7 of Table 2. *, ** and *** denote coefficients significantly different from 0 at, respectively, the 10% ($p<0.1$), 5% ($p<0.05$) and 1% ($p<0.001$) levels. Robust White heteroscedasticity corrected standard errors are given in parenthesis. Boxes in grey stand for their significance in cluster robustness checks by either sector or country. All veriables are in $\Delta$ ln. Tech gap in the interaction variables stands for the technology gap.

Table 12: Fixed effects regression (3) (Country, sector and year fixed effects) with 2-years lag for the trade and regulation variables and FDI regulation

| VARIABLES | (1) TFP growth | (2) TFP growth | (3) TFP growth | (4) TFP growth | (5) TFP growth |
|---|---|---|---|---|---|
| Technology gap | 0.00713 | 0.0105 | -0.000436 | 0.0143** | 0.00442 |
| | (0.00639) | (0.00747) | (0.00554) | (0.00674) | (0.0313) |
| High-skiled labor | -0.0302 | -0.0938*** | -0.0307 | -0.0309* | 0.0400 |
| | (0.0222) | (0.0357) | (0.0426) | (0.0176) | (0.101) |
| High-skiled labor*Tech gap | 0.0223 | 0.0665* | 0.0129 | 0.0290 | -0.0873 |
| | (0.0256) | (0.0349) | (0.0521) | (0.0206) | (0.114) |
| ICT-capital | 0.0245 | 0.0540* | -0.00592 | 0.0475*** | -0.0128 |
| | (0.0190) | (0.0275) | (0.0373) | (0.0178) | (0.152) |
| ICT-capital*Tech gap | -0.0415 | -0.0911** | -0.0262 | -0.0749*** | -0.0990 |
| | (0.0292) | (0.0358) | (0.0409) | (0.0264) | (0.160) |
| FDI inward stock | 0.00228 | | | | 0.0227 |
| | (0.00748) | | | | (0.0265) |
| FDI inward stock*Tech gap | -0.00382 | | | | -0.0246 |
| | (0.00887) | | | | (0.0300) |
| Services imports | | -6.78e-05 | | | -0.0277 |
| | | (0.0155) | | | (0.109) |
| Services imports*Tech gap | | -0.00700 | | | 0.0371 |
| | | (0.0213) | | | (0.116) |
| FATS sales | | | -0.000219 | | 0.0141 |
| | | | (0.00588) | | (0.0218) |
| FATS sales*Tech gap | | | 0.00132 | | -0.00433 |
| | | | (0.00630) | | (0.0177) |
| FDI inflows | | | | 0.00136 | |
| | | | | (0.00251) | |
| FDI inflows*Tech gap | | | | -0.00182 | |
| | | | | (0.00282) | |
| Entry barriers | -0.00586 | -0.0218 | 0.00613 | 0.00185 | 0.0824 |
| | (0.0253) | (0.0155) | (0.0224) | (0.0170) | (0.0884) |
| Entry barriers*Tech gap | 0.0173 | 0.0177 | -0.0125 | 0.00420 | -0.0859 |
| | (0.0274) | (0.0142) | (0.0207) | (0.0174) | (0.0962) |
| Conduct regulation | -0.139*** | -0.0285 | -0.124* | -0.0984** | -0.175 |
| | (0.0472) | (0.0387) | (0.0747) | (0.0439) | (0.256) |
| Conduct regulation*Tech gap | 0.170*** | 0.0284 | 0.139* | 0.0861* | 0.208 |
| | (0.0534) | (0.0419) | (0.0803) | (0.0496) | (0.236) |
| FDI restrictions | 0.0505* | -0.0161 | 0.0335 | -0.00550 | 0.0985 |
| | (0.0285) | (0.0435) | (0.0502) | (0.0336) | (0.112) |
| FDI restrictions*Tech gap | -0.0744** | -0.0461 | -0.0701 | -0.0147 | -0.158 |
| | (0.0313) | (0.0340) | (0.0618) | (0.0336) | (0.158) |
| Observations | 449 | 609 | 335 | 517 | 78 |
| R-squared | 0.300 | 0.322 | 0.329 | 0.293 | 0.543 |

Notes: The dependant variable is the level of TFP Definitions of Entry and Conduct regulations can be found in the footnotes 6 and 7 of Table 2. *, ** and *** denote coefficients significantly different from 0 at, respectively, the 10% ($p<0.1$), 5% ($p<0.05$) and 1% ($p<0.001$) levels. Robust White heteroscedasticity corrected standard errors are given in parenthesis. Boxes in grey stand for their significance in cluster robustness checks by either sector or country. The coefficient in the orange box has been corrected for mean effects in the main text. All veriables are in $\Delta$ ln. Tech gap in the interaction variables stands for the technology gap.

Table 13: Elasticities and significance of FDI Restrictions on MFP Growth when technology gap is closing - $\beta_{12}$ FDIRest $_{-2\ ijt}$ taken from equation (5.3) in the main text.

| Closing the Tech Gap | $\beta_{12}$ | Significance | Benchmark |
|---|---|---|---|
| 0,0 | 0,051 | * | |
| 0,1 | 0,043 | * | |
| 0,2 | 0,036 | | |
| 0,3 | 0,028 | | |
| 0,4 | 0,021 | | |
| 0,5 | 0,013 | | |
| 0,6 | 0,006 | | |
| 0,7 | -0,002 | | |
| 0,8 | -0,009 | | |
| 0,9 | -0,016 | | (0.945=$\mu$) |
| 1,0 | -0,024 | ** | US=1 |
| 1,1 | -0,031 | ** | |
| 1,2 | -0,039 | ** | |
| 1,3 | -0,046 | ** | |
| 1,4 | -0,054 | *** | |
| 1,5 | -0,061 | *** | |
| 1,6 | -0,071 | *** | |
| 1,7 | -0,079 | *** | |

Source: Author's calculations. Sample mean = 0.945 with a coefficient of (-0.0197) for FDI restrictions, with a standard error of (0.0112), yielding a *t*- statistic = -1.758 on TFP growth which is significant at the 10 per cent level. The US is set at 1 for the Technology gap which is in line with the literature. Figures remain significant until the maximum value of the Technology gap (See table 3: 3,871316). *, ** and *** denote coefficients significantly different from 0 at, respectively, the 10% ($p<0.1$), 5% ($p<0.05$) and 1% ($p<0.001$) levels. Robust White heteroscedasticity corrected standard errors are included in the regressions.

Table 14: Fixed effects regression (3) with 2-years lag for the trade and regulation variables and FDI regulation. High-skilled labor interactions included. Output for High-skilled labor and ICT (plus their interaction with Technology gap) capital omitted but corrected in the regression

| VARIABLES | (1) TFP growth | (2) TFP growth | (3) TFP growth | (4) TFP growth | (5) TFP growth |
|---|---|---|---|---|---|
| Output TFPgap, hhs and ICT-capit omittted | | | | | |
| FDI inward stock | 0.000742 | | | | -0.00332 |
| | (0.00754) | | | | (0.0276) |
| FDI inward stock*Tech gap | -0.00222 | | | | 0.00402 |
| | (0.00893) | | | | (0.0309) |
| Services imports | | -0.00115 | | | -0.129 |
| | | (0.0157) | | | (0.124) |
| Services imports*Tech gap | | -0.00519 | | | 0.222 |
| | | (0.0215) | | | (0.145) |
| FATS sales | | | -0.000513 | | 0.00522 |
| | | | (0.00583) | | (0.0232) |
| FATS sales*Tech gap | | | 0.00125 | | 0.00180 |
| | | | (0.00628) | | (0.0189) |
| FDI inflows | | | | 0.00111 | |
| | | | | (0.00258) | |
| FDI inflows*Tech gap | | | | -0.00151 | |
| | | | | (0.00292) | |
| Entry barriers | -0.00679 | -0.0233 | 0.0433* | 0.00254 | 0.0557 |
| | (0.0284) | (0.0171) | (0.0262) | (0.0165) | (0.103) |
| Entry barriers*Tech gap | 0.0165 | 0.0201 | -0.0394* | 0.00575 | -0.0549 |
| | (0.0324) | (0.0144) | (0.0218) | (0.0175) | (0.111) |
| Entry barriers*High-skilled labor | 0.0255 | 0.00836 | -0.117** | -0.0125 | -0.197 |
| | (0.0434) | (0.0434) | (0.0465) | (0.0219) | (0.268) |
| Conduct regulation | -0.136*** | -0.0212 | -0.147* | -0.0990** | 0.0114 |
| | (0.0457) | (0.0400) | (0.0782) | (0.0441) | (0.209) |
| Conduct regulation*Tech gap | 0.171*** | 0.0217 | 0.159* | 0.0868* | 0.0272 |
| | (0.0520) | (0.0425) | (0.0824) | (0.0501) | (0.190) |
| Conduct reg.*High-skilled labor | -0.0436 | -0.205 | -0.0600 | 0.000972 | -0.673 |
| | (0.0944) | (0.151) | (0.123) | (0.116) | (0.619) |
| FDI restrictions | 0.0621** | -0.00863 | 0.0416 | -0.00477 | 0.0794 |
| | (0.0280) | (0.0421) | (0.0477) | (0.0339) | (0.119) |
| FDI restrictions*Tech gap | -0.0831*** | -0.0460 | -0.0589 | -0.0139 | -0.0636 |
| | (0.0302) | (0.0356) | (0.0610) | (0.0339) | (0.149) |
| FDI restrictions*High-skilled labor | -0.157*** | -0.181 | -0.526*** | -0.0242 | -1.585*** |
| | (0.0594) | (0.187) | (0.162) | (0.0680) | (0.508) |
| Observations | 449 | 609 | 335 | 517 | 78 |
| R-squared | 0.306 | 0.331 | 0.370 | 0.295 | 0.632 |

Notes: The dependant variable is the level of TFP Definitions of Entry and Conduct regulations can be found in the footnotes 6 and 7 of Table 2. *, ** and *** denote coefficients significantly different from 0 at, respectively, the 10% ($p<0.1$), 5% ($p<0.05$) and 1% ($p<0.001$) levels. Robust White heteroscedasticity corrected standard errors are given in parenthesis. Boxes in grey stand for their significance in cluster robustness checks by either sector or country. The coefficient in the orange box has been corrected for mean effects in the main text. All veriables are in $\Delta$ ln. Tech gap in the interaction variables stands for the technology gap.

Table 15: Elasticities and significance of FDI Restrictions on MFP Growth when technology gap is closing - $\beta_{12}$ FDIRest $_{-2\ ijt}$ taken from equation (5.3) in the main text (Table 14).

| Closing the Tech Gap | $\beta_{12}$ | Significance | Benchmark |
|---|---|---|---|
| 0,0 | 0,062 | ** | |
| 0,1 | 0,054 | ** | |
| 0,2 | 0,046 | ** | |
| 0,3 | 0,037 | * | |
| 0,4 | 0,029 | * | |
| 0,5 | 0,021 | | |
| 0,6 | 0,012 | | |
| 0,7 | 0,004 | | |
| 0,8 | -0,004 | | |
| 0,9 | -0,013 | | (0.945=$\mu$) |
| 1,0 | -0,021 | * | US=1 |
| 1,1 | -0,029 | ** | |
| 1,2 | -0,038 | ** | |
| 1,3 | -0,046 | *** | |
| 1,4 | -0,054 | *** | |
| 1,5 | -0,063 | *** | |
| 1,6 | -0,071 | *** | |
| 1,7 | -0,079 | *** | |

Source: Author's calculations. Sample mean = 0.945 with a coefficient of (-0.0164) for FDI restrictions, with a standard error of (0.0110), yielding a *t*- statistic = -1.491 on TFP growth which is not significant. The US is set at 1 for the Technology gap which is in line with the literature. Figures remain significant until the maximum value of the Technology gap (See table 3: 3,871316). *, ** and *** denote coefficients significantly different from 0 at, respectively, the 10% ($p<0.1$), 5% ($p<0.05$) and 1% ($p<0.001$) levels. Robust White heteroscedasticity corrected standard errors are given in parenthesis.

Table 16: Extra robustness checks for only Business services fixed effects regression (3) with 2-years lag for the trade and regulation variables and FDI regulation. High-skilled labor interactions included. Output for High-skilled labor and ICT (plus their interaction with Technology gap) capital omitted but corrected in the regression

| VARIABLES | (1) TFP growth | (2) TFP growth | (3) TFP growth | (4) TFP growth | (5) TFP growth |
|---|---|---|---|---|---|
| Output TFPgap, hhs and ICT-capit omittted | | | | | |
| FDI inward stock | 0.00220 | | | | 0.000994 |
| | (0.0103) | | | | (0.0277) |
| FDI inward stock*Tech gap | -0.00351 | | | | -0.000364 |
| | (0.0115) | | | | (0.0310) |
| Services imports | | -0.00116 | | | -0.129 |
| | | (0.0157) | | | (0.121) |
| Services imports*Tech gap | | -0.00517 | | | 0.214 |
| | | (0.0215) | | | (0.143) |
| FATS sales | | | -0.00281 | | 0.0118 |
| | | | (0.00724) | | (0.0248) |
| FATS sales*Tech gap | | | 0.00677 | | -0.00291 |
| | | | (0.00744) | | (0.0200) |
| FDI inflows | | | | 0.00116 | |
| | | | | (0.00300) | |
| FDI inflows*Tech gap | | | | -0.00179 | |
| | | | | (0.00327) | |
| Entry barriers | -0.00674 | -0.0230 | 0.0409 | 0.00774 | 0.0695 |
| | (0.0294) | (0.0171) | (0.0274) | (0.0172) | (0.104) |
| Entry barriers*Tech gap | 0.0186 | 0.0200 | -0.0352 | 0.00204 | -0.0643 |
| | (0.0335) | (0.0144) | (0.0226) | (0.0187) | (0.112) |
| Entry barriers*High-skilled labor | 0.00474 | 0.00709 | -0.0962* | -0.0156 | -0.192 |
| | (0.0446) | (0.0434) | (0.0502) | (0.0234) | (0.270) |
| Conduct regulation | -0.140*** | -0.0215 | -0.134* | -0.106** | -0.0185 |
| | (0.0524) | (0.0399) | (0.0758) | (0.0493) | (0.216) |
| Conduct regulation*Tech gap | 0.167*** | 0.0219 | 0.129 | 0.0909* | 0.0446 |
| | (0.0565) | (0.0424) | (0.0786) | (0.0544) | (0.195) |
| Conduct reg.*High-skilled labor | 0.00907 | -0.206 | 0.00833 | -0.0143 | -0.584 |
| | (0.102) | (0.151) | (0.140) | (0.128) | (0.638) |
| FDI restrictions | 0.0640* | -0.00951 | 0.0292 | 0.00514 | 0.0941 |
| | (0.0329) | (0.0420) | (0.0566) | (0.0386) | (0.122) |
| FDI restrictions*Tech gap | -0.0771** | -0.0454 | -0.0254 | -0.0238 | -0.0863 |
| | (0.0343) | (0.0354) | (0.0707) | (0.0375) | (0.155) |
| FDI restrictions*High-skilled labor | -0.129* | -0.174 | -0.520*** | -0.00755 | -1.456** |
| | (0.0663) | (0.187) | (0.175) | (0.0747) | (0.545) |
| Observations | 333 | 602 | 258 | 389 | 73 |
| R-squared | 0.265 | 0.328 | 0.348 | 0.276 | 0.643 |

Notes: The dependant variable is the level of TFP Definitions of Entry and Conduct regulations can be found in the footnotes 6 and 7 of Table 2. *, ** and *** denote coefficients significantly different from 0 at, respectively, the 10% ($p<0.1$), 5% ($p<0.05$) and 1% ($p<0.001$) levels. Robust White heteroscedasticity corrected standard errors are given in parenthesis. Boxes in grey stand for their significance in cluster robustness checks by either sector or country. The coefficient in the orange box has been corrected for mean effects in the main text. All veriables are in $\Delta$ ln. Tech gap in the interaction variables stands for the technology gap.

Table 17: Average Share of High-skilled labor of total labor force per service sector

| Service sector | Share of High-skilled labor of total labor force |
|---|---|
| Business & Renting | 29,82 |
| Com Soc Personal services | 27,53 |
| Communication services | 11,64 |
| Construction | 8,05 |
| Distribution services | 9,56 |
| Education | 47,08 |
| Electr Gas Water | 14,97 |
| Fin Ins Real Bus | 28,49 |
| Finance | 26,03 |
| Health | 26,49 |
| Other Personal services | 16,90 |
| Public Administration | 24,96 |
| Real Est. Rent. Business | 29,35 |
| Real Estate | 25,96 |
| Tourism | 7,21 |
| Transport services | 7,81 |
| Transp Storage & Communication | 8,63 |

Source: EUKlems, author's calcualtions