Web Appendix for: Market Services Productivity Across Europe and the US

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Appendix 4 Robustness analysis

In this Appendix, we show the robustness analysis underlying our regression analysis in Section 4. In turn, we will discuss the effect of ICT, human capital and regulatory entry barriers on MFP growth.

4.1 ICT and MFP growth – Robustness analysis

Based on the analysis in Table 8, we concluded that ICT use was not systematically related to MFP growth. Here we look at this issue in more detailed, first by looking at the effect of using longer differences as in Brynjolfsson and Hitt (2003). On the one hand, this is likely to reduce the impact of measurement errors in the variables. Furthermore, Brynjolfsson and Hitt (2003) argue that such regressions reflect a long-run relationship between ICT use and MFP growth and in the long-run adjustments to the organization will have taken place. Their sample covered 7 years of firm-level data and they find the largest impact of ICT on MFP growth once they average over all 7 years. In **Table A4**, we look at the annual growth rates as reported in Table 8 and, following Brynjolfsson and Hitt (2003), overlapping periods of 5 years and 10 years. The table shows that the coefficients do not increase for longer time horizons and, in the case of the share of ICT capital compensation in output, there is even weak evidence of a significant negative relationship between ICT use and MFP growth.

The effects of ICT may also be industry- or country-specific. For instance, it may be easier to make the necessary organizational adjustments in some industries than in others. Furthermore, these complementary investments may be hampered or helped by the institutional setting of the country. For instance, if employment protection is relatively strict, radical organizational change may be harder to achieve. **Table A5** shows industry-by-industry estimates and **Table A6** shows country-by-country estimates of the relationship between ICT use and MFP growth. Both tables show a very mixed picture. In Table A5, the finance and business services industries are the only two to show a significant negative relationship between ICT use and MFP growth. Moreover, the two ICT measures do not give a consistent picture in this respect. The country-by-country estimates in Table A6 are similar: some countries show significant negative coefficients, but not consistently across measures (with the partial exception of Spain). Overall, this evidence is sufficiently mixed that we feel that we cannot reject the hypothesis that ICT use generates normal productive returns.

4.2 Human capital and MFP growth – Robustness analysis

In the main text, we showed that a greater share of high-skilled workers has no relation with MFP growth at the industry level, regardless of the distance to the productivity frontier (Table 9). We also showed that the more positive findings for the total economy by Vandenbussche *et al.* (2006, VAM henceforth) are sensitive to the sophistication of the productivity measure used. In this Appendix, we demonstrate the robustness of these findings, first by showing which productivity measurement refinements matter for the sensitivity of the VAM results and next by showing that the lack of a relationship between MFP growth and high-skilled workers is a robust finding at the industry level. The basic estimating equation throughout is as follows:

$$\Delta \ln MFP^i = \beta \ln\left(MFP^F / MFP^i\right) + \gamma H + \delta H * \ln\left(MFP^F / MFP^i\right) \qquad \text{(A12)}$$

where the growth rate of MFP in country i is explained by the relative level to the frontier F, the share of high-skilled H and an interaction. According to VAM, β should be positive, as a greater gap relative to the frontier increases the opportunities for imitation, γ should be positive as more high-skilled workers increase growth and the interaction δ should be negative since the effect of high-skilled workers decreases as the productivity gap increases. We will show results both including and excluding the interaction term.

Table A7 shows the effect of using more sophisticated MFP measures on the relationship between high-skilled workers and MFP growth for the economy as a whole. The first line of Table A7 shows the same information as the part of Table 9 labeled 'Crude MFP' for the total economy, while the final line shows the results labeled 'Sophisticated MFP'. For the results in this table, we only include year dummies, as VAM reached their strongest results in this setting.[1] As the table shows, the skill-MFP relationship is most sensitive to correcting for differences and changes in hours worked. After this correction, the presence of more high-skilled workers is no longer significantly different from zero. When differences and changes in hours worked by different types of workers are also accounted for, the t-statistics become smaller than one and point

[1] The skill data used by VAM necessitated measuring all variables at 5-year intervals. The results in this table are qualitatively similar if we had used skill data from the same sources as VAM and if we had measured all variables at 5-year intervals. Including country dummies in addition to year dummies leads to more mixed results, but does not show a robust positive effect of a larger share of high-skilled workers on MFP growth, or a negative interaction term between the high-skilled share and the MFP productivity gap (VAM also found this result). These additional results are available on request.

estimate of the interaction term changes from negative to positive, although it is never significant. In other words, we only find similar results to VAM when using the crudest of MFP measures.

Table A8 mirrors the previous table, except that these results are based on industry-level estimates. It turns out that the industry-level results are not very sensitive to the productivity measures used. In all estimates, the convergence coefficient β is positive and significant, while a greater high-skilled share is not related to MFP growth and the interaction is never significant.

Krueger and Lindahl (2001) and de la Fuente and Doménech (2006) have shown how the quality of the education data can affect the results, so we also look at a variety of other measures capturing the share of high-skilled workers. In addition to our industry-level measure of the share of university-educated workers in total hours worked, we also examine a broader measure that includes workers with a degree beyond high school and analyze the labour compensation share of both groups too. The labour compensation share is equal to the share in hours worked times the wage premium of the group, thereby taking into account that in some countries and industries, a university education commands a higher wage premium. This would reflect at least in part the quality differences in university education. Finally, we draw upon the same skill data as VAM, namely the education data of Barro and Lee (2000, BL) and those of de la Fuente and Doménech (2006, DD). These data refer to the country-wide share of the working-age population with either some university education or a completed university education. VAM use the data on the population share with some university education. As the BL and DD are available only once every 5 years, we interpolate between those years. Appendix Table 3 uses the most sophisticated MFP measures (measure 6), and looks at the effect of using these different high-skilled share measures.[2] **Table A9** shows one coefficient that is significantly positive at the 10%-level, but overall, the same picture emerges as from Table A8: there is no relationship between the share of high-skilled workers and MFP growth at the industry level, regardless of the distance of the industry to the frontier.

As another set of robustness checks, we look at the effect of the year, industry and country dummies. In our industry estimates up to this point, we always included a full set of dummies. In **Table A10**, we include different variations of year, industry and country dummies. Some of these variations suggest a negative relationship between the high-skilled share and MFP growth, but in all specifications with industry dummies, this relationship is insignificant.

In **Table A11** we examine whether over a longer time horizon, the share of high-skilled workers affects productivity growth. This is comparable to Table A4 for ICT and brings the specification closer to that of VAM since they have data measured at 5-year intervals. The table shows that, if anything, the VAM hypothesis is more soundly rejected for longer differences. Taken together, the evidence for a positive impact of high-skilled workers on the rate of innovation at the country or industry level is largely absent and the supportive evidence for this hypothesis by VAM seems sensitive to the use of crude MFP measures at the economy-wide level. This suggests that on average, the social return does not exceed the private return to a university degree. As a result, the

[2] The results are similar for the other MFP measures. The BL data are available up to 2000 and the DD up to 1995. Restricting the sample to 1980-1995 for all measures does not affect the results. Both results are available on request..

effects of skilled labour on the rate of innovation should be examined at a more detailed level, such as start-up firms.

So far, we have analyzed the role of ICT use and use of skilled labour in isolation. However, there is a substantial literature on the complementarities between skilled labour and ICT use (e.g. Autor, Katz and Krueger, 1998; Bresnahan, Brynjolfsson and Hitt, 2002). A straightforward way to test whether this complementarity influences our conclusions so far, we include either of our ICT measures and the high-skilled share simultaneously in our regressions. In addition to including the variables themselves, we also include interactions between all variables. **Table A12** shows that regressions with both explanatory variables included do not lead to different findings than the single-variable regressions we have employed up to now. This does not imply a lack of complementarities between skills and ICT in our dataset, but only that neither variable is systematically related to industry MFP growth.[3]

4.3 Regulation and MFP growth – Robustness analysis

The key finding from the analysis in the main text was that reductions in the barriers to entry in the telecommunications industry boosted MFP growth, while a similar effect was not found in the transport sector. Also, we could not find an effect of more aggregate measures of barriers to entry. In this appendix, we show first some results using alternative OECD regulation indicators, second, the robustness of our findings for telecommunications and finally, an analysis for more detailed transport industries using labour productivity data.

Over the last years, the OECD has put out a large number of regulatory indicators, varying in the specificity of coverage as well as the time period. To draw meaningful conclusions about the effects of changes in regulation, some time variation or cross-industry variation is needed. In addition to the indicators used in Tables 10 and 11, we also examined the effect of entry liberalization in non-manufacturing industries (changes in barriers to entry) and the level of and changes in regulation impact. This regulation impact indicator, introduced in Conway *et al.* (2006), assumes that industries that buy more of the products of a highly-regulated industry are more affected by the lack of competition in this upstream industry. As inputs, they use the overall regulation indices of non-manufacturing industries, which included barriers to entry as well as other regulatory dimensions (see Conway and Nicoletti, 2006). **Table A13** reports the results from using those three additional regulation indices to explain MFP growth. To a large extent, the results mirror those using the average barriers to entry in Table 10: most effects or not significant and only the change in regulation impact has a weakly significant effect.

To probe the robustness of our finding for the telecommunications industry, we have analyzed a variety of different variants. In particular, we excluded country and year dummies; we varied the time period covered and we analyzed whether barriers to entry drive the effect or another dimension of regulation in this industry. As **Table A14** shows, the country and year dummies have a large impact on the results: only when fixed country effects are accounted for, we find a significant effect of lower barriers to entry.

[3] The ICT share and the share of high-skilled workers are positively correlated, even after taking into account industry, country and year effects, which is in line with earlier findings of complementarities.

Also, taking into account both country and year effects double the size of the effect compared to the case where only country effects are accounted for.

Looking at different subperiods is also informative. The 1984-1998 period is the same as used by Nicoletti and Scarpetta (2003) and shows a substantially larger effect of barriers to entry than the full 1980-2004 period; the 1980-1995 period shows no significant effect, while the 1990-2004 effect is similar to that for the full period. The reason for this disparity seems to be the timing of entry deregulation, with most countries initiating reform around 1990 and most barriers removed by 2003 (see Conway and Nicoletti, 2006).

Regulatory restrictions in telecommunications consist of three dimensions according to the OECD indicators, namely barriers to entry, public ownership and market structure. Barriers to entry is the clearest regulatory indicator as it shows whether there is free entry in the different segments of the industry (trunk, international and mobile telephony) or if the segment is restricted to either one or two firms. Public ownership measures the share of government ownership in the public telecommunications operator and the largest mobile communications firm and market structure measures the market share of new entrants in the different market segments. This is more properly an outcome measure of the regulatory process. **Table A15** looks at the effect of the three different regulation indicators. As the table shows, barriers to entry is the only indicator with a strongly significant negative impact on MFP growth, confirming that lower barriers to entry have the predicted effect on productivity growth.

Table A4: The effect of ICT use on MFP growth for longer differences

Dependent variable: MFP growth	Annual growth	5-year growth	10-year growth	Annual growth	5-year growth	10-year growth
Growth of ICT capital services						
Technology gap	0.019***	0.021***	0.022***	0.014**	0.016***	0.016***
	(0.004)	(0.004)	(0.003)	(0.005)	(0.006)	(0.005)
ICT use	-0.024***	-0.034***	-0.026**	-0.038***	-0.046***	-0.040**
	(0.009)	(0.012)	(0.013)	(0.014)	(0.016)	(0.020)
Technology gap*ICT use				0.038	0.033	0.040
				(0.024)	(0.032)	(0.031)
Share of ICT capital compensation in output						
Technology gap	0.020***	0.022***	0.022***	0.021***	0.020***	0.021***
	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)
ICT use	-0.053	-0.049*	-0.034*	-0.034	-0.067*	-0.050*
	(0.035)	(0.029)	(0.019)	(0.023)	(0.039)	(0.028)
Technology gap*ICT use				-0.033	0.032	0.027
				(0.089)	(0.097)	(0.077)
Number of observations	2376	1980	1485	2376	1980	1485

Notes:
Dependent variables is MFP growth in market services industries between 1980 and 2004, independent variables is the technology gap relative to the frontier country and the measures of ICT use. Standard errors, consistent for heteroscedasticity and autocorrelation are in parentheses. *, ** and *** denote a coefficient significantly different from zero, respectively, at the 10, 5 and 1 percent level. Year, country and industry dummies are included in all regressions. The columns labelled 'Annual growth' use annual MFP growth, the technology gap in the initial year and ICT use for this year as variables. The columns labelled 5-year growth use overlapping 5-year averages of MFP growth, the technology gap in the initial year and ICT use over this period as variables. The columns labelled 10-year growth are defined analogously.

Table A5: Industry-by-industry estimates of the relationship between ICT use and productivity growth

Dependent variable: MFP growth	Technology gap		ICT use	
	coefficient	s.e.	coefficient	s.e.
Growth of ICT capital services				
Motor trade	0.054***	(0.019)	-0.005	(0.022)
Wholesale trade	0.040**	(0.018)	0.043	(0.030)
Retail trade	0.122***	(0.030)	0.011	(0.018)
Hotels and restaurants	0.065***	(0.024)	-0.020	(0.015)
Transport and storage	0.108***	(0.037)	0.000	(0.014)
Telecommunications	0.058***	(0.020)	-0.065*	(0.037)
Financial intermediation	0.106***	(0.030)	-0.089***	(0.033)
Business services	0.142***	(0.026)	-0.026	(0.027)
Social and personal services	0.174***	(0.039)	-0.028	(0.020)
Share of ICT capital compensation in output				
Motor trade	0.057**	(0.025)	0.154	(0.855)
Wholesale trade	0.055**	(0.026)	0.466	(0.409)
Retail trade	0.118***	(0.029)	-0.195	(0.270)
Hotels and restaurants	0.081***	(0.025)	0.315	(0.254)
Transport and storage	0.113***	(0.034)	-0.249	(0.185)
Telecommunications	0.052**	(0.021)	0.071	(0.089)
Financial intermediation	0.113***	(0.030)	-0.135	(0.131)
Business services	0.126***	(0.029)	-0.303**	(0.140)
Social and personal services	0.178***	(0.038)	0.214	(0.246)

Notes:
Dependent variables is annual MFP growth in individual market services industries between 1980 and 2004, independent variables is the technology gap relative to the frontier country and the measures of ICT use. Standard errors, consistent for heteroscedasticity and autocorrelation are in parentheses. *, ** and *** denote a coefficient significantly different from zero, respectively, at the 10, 5 and 1 percent level. Year and country dummies are included in all regressions. All regressions are based on 216 observations.

Table A6: Country-by-country estimates of the relationship between ICT use and productivity growth

	Technology gap		ICT use	
	coefficient	s.e.	coefficient	s.e.
Growth of ICT capital services				
Austria	0.056*	(0.030)	0.061	(0.051)
Belgium	0.092***	(0.032)	-0.032	(0.030)
Denmark	0.050**	(0.024)	-0.015	(0.019)
Finland	0.071**	(0.035)	-0.020	(0.032)
France	0.049*	(0.027)	-0.032	(0.022)
Germany	0.066***	(0.024)	-0.078*	(0.047)
Italy	0.075***	(0.021)	-0.003	(0.040)
Netherlands	0.077***	(0.026)	-0.044*	(0.025)
Spain	0.056	(0.034)	-0.103***	(0.033)
UK	0.047**	(0.022)	-0.012	(0.016)
US	0.038***	(0.013)	-0.093***	(0.024)
Share of ICT capital compensation in output				
Austria	0.072**	(0.035)	0.254**	(0.108)
Belgium	0.115***	(0.030)	-1.115***	(0.348)
Denmark	0.053**	(0.024)	-0.006	(0.103)
Finland	0.049	(0.033)	-0.236	(0.165)
France	0.053**	(0.026)	-0.163	(0.110)
Germany	0.074***	(0.023)	-0.242	(0.155)
Italy	0.074***	(0.022)	0.169	(0.116)
Netherlands	0.069**	(0.027)	-0.447**	(0.198)
Spain	0.063	(0.041)	-0.350*	(0.202)
UK	0.049**	(0.022)	-0.054	(0.132)
US	0.032*	(0.017)	0.056	(0.193)

Notes:
Dependent variables is annual MFP growth in individual market services industries between 1980 and 2004, independent variables is the technology gap relative to the frontier country and the measures of ICT use. Standard errors (s.e.), consistent for heteroscedasticity and autocorrelation are in parentheses. *, ** and *** denote a coefficient significantly different from zero, respectively, at the 10, 5 and 1 percent level. Year and industry dummies are included in all regressions. All regressions are based on 264 observations.

Table A7: Human capital results for aggregate economy: different productivity measures

	Technology gap	Skill	Technology gap	Skill	Technology gap*Skill
MFP measure					
1	0.027**	0.043**	0.044**	0.065**	-0.106
	(0.011)	(0.020)	(0.020)	(0.027)	(0.126)
2	0.018*	0.029	0.025	0.043	-0.049
	(0.009)	(0.021)	(0.017)	(0.034)	(0.121)
3	0.016	0.016	0.005	-0.010	0.078
	(0.010)	(0.023)	(0.019)	(0.045)	(0.139)
4	0.014	0.020	0.009	0.009	0.037
	(0.008)	(0.023)	(0.014)	(0.038)	(0.123)
5	0.018**	0.023	0.015	0.013	0.028
	(0.008)	(0.023)	(0.013)	(0.042)	(0.117)
6	0.015*	0.004	0.007	-0.009	0.056
	(0.008)	(0.016)	(0.014)	(0.034)	(0.121)

Notes:

Dependent variables are different measures of annual MFP growth for the aggregate economy between 1980 and 2004, independent variables are measures of the technology gap relative to the frontier country and the share of high-skilled workers in total hours worked. Standard errors, consistent for heteroscedasticity and autocorrelation are in parentheses. * and ** denote a coefficient significantly different from zero at the 10 and 5 percent level. Year dummies are included in all regressions.

MFP measure: (output measure, PPP, labour measure, capital measure)

1	Value added, GDP PPP, Persons engaged, capital stock
2	Value added, GDP PPP, Total hours worked, capital stock
3	Value added, GDP PPP, Hours worked by type, capital stock
4	Value added, GO PPP, Hours worked by type, capital stock
5	Value added, GO PPP, Hours worked by type, capital services
6	Gross output, IO PPP, Hours worked by type, capital services

Table A8: Human capital results at the industry level: different productivity measures

	Technology gap	Skill	Technology gap	Skill	Technology gap*Skill
MFP measure					
1	0.027***	-0.017	0.021***	-0.034	0.050
	(0.005)	(0.035)	(0.007)	(0.038)	(0.038)
2	0.033***	-0.017	0.033***	-0.018	0.005
	(0.005)	(0.035)	(0.008)	(0.040)	(0.039)
3	0.033***	-0.031	0.039***	-0.016	-0.039
	(0.005)	(0.036)	(0.007)	(0.041)	(0.037)
4	0.030***	-0.032	0.034***	-0.018	-0.030
	(0.005)	(0.036)	(0.006)	(0.040)	(0.029)
5	0.032***	-0.029	0.036***	-0.015	-0.031
	(0.005)	(0.037)	(0.006)	(0.039)	(0.032)
6	0.019***	-0.019	0.020***	-0.017	-0.006
	(0.004)	(0.023)	(0.005)	(0.023)	(0.034)

Notes:
Dependent variables are different measures of annual MFP growth for nine market services between 1980 and 2004, independent variables are measures of the technology gap relative to the frontier country and the share of high-skilled workers in total hours worked. Standard errors, consistent for heteroscedasticity and autocorrelation are in parentheses. *** denotes a coefficient significantly different from zero at the 1 percent level. Country, industry and year dummies are included in all regressions. Description of MFP measures is the same as in Table A7.

Table A9: Human capital results at the industry level: different skill measures

	Technology gap	Skill	Technology gap	Skill	Technology gap*Skill
High-skilled share measure					
1	0.019***	-0.019	0.020***	-0.017	-0.006
	(0.004)	(0.023)	(0.005)	(0.023)	(0.034)
2	0.019***	0.004	0.027**	0.010	-0.010
	(0.004)	(0.010)	(0.011)	(0.013)	(0.015)
3	0.019***	-0.028*	0.019***	-0.028*	0.000
	(0.004)	(0.014)	(0.005)	(0.013)	(0.024)
4	0.019***	-0.004	0.023*	-0.001	-0.005
	(0.004)	(0.009)	(0.013)	(0.013)	(0.017)
5	0.023***	0.085	0.021***	0.077	0.036
	(0.004)	(0.075)	(0.006)	(0.074)	(0.063)
6	0.023***	0.090*	0.021***	0.086*	0.016
	(0.004)	(0.048)	(0.006)	(0.048)	(0.035)
7	0.034***	0.133	0.022***	0.112	0.154**
	(0.005)	(0.146)	(0.008)	(0.145)	(0.075)
8	0.034***	-0.076	0.022***	-0.087	0.077**
	(0.005)	(0.068)	(0.007)	(0.067)	(0.036)

Notes:

Dependent variable is annual MFP growth for nine market services between 1980 and 2004 (MFP measure 6 from Table A8), independent variables is the technology gap relative to the frontier country and different measures of the share of high-skilled workers. Standard errors, consistent for heteroscedasticity and autocorrelation are in parentheses. *, ** and *** denote a coefficient significantly different from zero at, respectively, the 10%, 5% and 1% level. Country, industry and year dummies are included in all regressions.

High-skilled share measures:

1	University-educated workers in total hours worked (EU KLEMS)
2	University-educated and vocactional-educated workers in total hours worked (EU KLEMS)
3	University-educated workers in labour compensation (EU KLEMS)
4	University-educated and vocactional-educated workers in labour compensation (EU KLEMS)
5	Population older than 15 with completed post-secondary education (Barro-Lee)
6	Population older than 15 with some post-secondary education (Barro-Lee)
7	Population older than 15 with completed post-secondary education (de la Fuente-Doménech)
8	Population older than 15 with some post-secondary education (de la Fuente-Doménech)

Table A10: Human capital results at the industry level: different dummy controls

	Technology gap	Skill	Technology gap	Skill	Technology gap*Skill
Dummies					
None	0.020***	-0.008	0.014***	-0.032***	0.066**
	(0.003)	(0.008)	(0.004)	(0.011)	(0.033)
Year	0.021***	-0.010	0.015***	-0.033***	0.065*
	(0.003)	(0.008)	(0.004)	(0.011)	(0.033)
Industry	0.013***	0.006	0.010**	-0.006	0.029
	(0.003)	(0.011)	(0.004)	(0.014)	(0.034)
Country	0.024***	-0.015	0.021***	-0.027**	0.035
	(0.004)	(0.010)	(0.004)	(0.012)	(0.033)
Year+Industry	0.013***	0.004	0.011**	-0.009	0.029
	(0.003)	(0.011)	(0.004)	(0.015)	(0.035)
Year+Country	0.025***	-0.020**	0.022***	-0.030***	0.031
	(0.004)	(0.010)	(0.004)	(0.011)	(0.033)
Industry+Country	0.018***	-0.005	0.018***	-0.003	-0.005
	(0.004)	(0.020)	(0.005)	(0.020)	(0.034)
Year+Industry+Country	0.019***	-0.019	0.020***	-0.017	-0.006
	(0.004)	(0.023)	(0.005)	(0.023)	(0.034)

Notes:

Dependent variable is annual MFP growth for nine market services between 1980 and 2004 (MFP measure 6 from Table A8), independent variables is the technology gap relative to the frontier country and the share of high-skilled workers in total hours worked (Skill measure 1 from Table A9). Standard errors, consistent for heteroscedasticity and autocorrelation are in parentheses. *, ** and *** denote a coefficient significantly different from zero at, respectively, the 10%, 5% and 1% level.

Table A11: Human capital results at the industry level: longer differences

	Technology gap	Skill	Technology gap	Skill	Technology gap*Skill
Difference length					
Annual growth	0.019***	-0.019	0.020***	-0.017	-0.006
	(0.004)	(0.023)	(0.005)	(0.023)	(0.034)
5-year growth	0.022***	-0.025	0.021***	-0.029	0.009
	(0.004)	(0.022)	(0.004)	(0.022)	(0.032)
10-year growth	0.022***	-0.026*	0.020***	-0.035*	0.019
	(0.003)	(0.016)	(0.004)	(0.018)	(0.018)

Notes:

Dependent variable is MFP growth for nine market services between 1980 and 2004 (MFP measure 6 from Table A8), independent variables is the technology gap relative to the frontier country and the share of high-skilled workers in total hours worked (Skill measure 1 from Table A9). Standard errors, consistent for heteroscedasticity and autocorrelation are in parentheses. *, ** and *** denote a coefficient significantly different from zero at, respectively, the 10%, 5% and 1% level. The row labeled 'Annual growth' uses annual MFP growth, the technology gap in the initial year and the high-skilled share for this year as variables. The row labelled 5-year growth uses overlapping 5-year averages of MFP growth, the technology gap in the initial year and the average high-skilled share over this period as variables. The row labelled 10-year growth is defined analogously.

Table A12, The effect of ICT use and human capital on MFP growth

	Growth of ICT capital services			Share of ICT capital in output		
	1	2	3	4	5	6
Technology gap	0.019***	0.014***	0.017***	0.019***	0.021***	0.021***
	(0.004)	(0.005)	(0.006)	(0.004)	(0.005)	(0.005)
ICT use	-0.025***	-0.038***	-0.014	-0.049	-0.034	0.014
	(0.009)	(0.012)	(0.016)	(0.033)	(0.057)	(0.058)
High-skilled share	-0.023	-0.021	0.006	-0.014	-0.012	0.013
	(0.023)	(0.022)	(0.023)	(0.023)	(0.022)	(0.027)
Technology gap*ICT use		0.036	0.029		-0.027	-0.055
		(0.024)	(0.024)		(0.089)	(0.089)
Technology gap*High-skilled share		-0.001	-0.018		-0.003	0.019
		(0.033)	(0.030)		(0.035)	(0.034)
ICT use*High-skilled share			-0.225***			-0.297
			(0.085)			(0.189)

Notes:
Dependent variable is annual MFP growth for nine market services between 1980 and 2004 (MFP measure 6 from Table A8), independent variables is the technology gap relative to the frontier country, measures of ICT use and the share of high-skilled workers in total hours worked (Skill measure 1 from Table A9). Standard errors, consistent for heteroscedasticity and autocorrelation are in parentheses. *, ** and *** denote a coefficient significantly different from zero at, respectively, the 10%, 5% and 1% level.

Table A13: The effect of alternative regulatory indicators on productivity growth in market services

	Entry liberalization		Regulation impact		Change in regulation impact	
Technology gap	0.019***	0.020***	0.017***	0.015*	0.017***	0.018***
	(0.004)	(0.004)	(0.004)	(0.009)	(0.004)	(0.004)
Regulation	-0.004	-0.003	-0.006	-0.009	-0.030*	-0.079*
	(0.007)	(0.008)	(0.007)	(0.011)	(0.018)	(0.042)
Regulation*Technology gap		-0.003		0.006		0.105
		(0.024)		(0.017)		(0.078)
Number of observations	2376	2376	2112	2112	2112	2112

Notes:
Dependent variable in the regressions is annual MFP growth in market services industries, independent variables are the technology gap of the industry relative to the productivity frontier and measures of regulation. *, ** and *** denote a coefficient significantly different from zero at, respectively, 10%, 5% and 1% level. Standard errors, consistent for heteroscedasticity and autocorrelation, are in parentheses. Entry liberalization measures the change in average barriers to entry of non-manufacturing industries. Regulation impact is the weighted regulation index of non-manufacturing industries delivering intermediate inputs (see Conway and Nicoletti, 2006).

Table A14, Robustness of the impact of barriers to entry on productivity growth in telecommunications

	Baseline (country & year dummies, 1980-2004)	Single constant	Year dummies	Country dummies	1984-1998	1980-1995	1990-2004
Technology gap	0.077***	0.003	-0.001	0.036**	0.167***	0.219***	0.069**
	(0.023)	(0.010)	(0.010)	(0.018)	(0.063)	(0.043)	(0.029)
Barriers	-0.041***	-0.009	0.004	-0.016***	-0.083***	-0.035	-0.032***
	(0.012)	(0.007)	(0.012)	(0.006)	(0.017)	(0.021)	(0.011)
Technology gap	0.068***	-0.001	-0.009	0.025	0.106*	0.196***	0.062**
	(0.023)	(0.018)	(0.020)	(0.019)	(0.062)	(0.066)	(0.029)
Barriers	-0.060***	-0.013	-0.003	-0.034**	-0.144***	-0.044	-0.059**
	(0.039)	(0.015)	(0.017)	(0.014)	(0.030)	(0.034)	(0.023)
Barriers*Technology gap	0.037	0.009	0.016	0.035	0.097***	0.026	0.049
	(0.029)	(0.026)	(0.028)	(0.026)	(0.037)	(0.040)	(0.037)
Number of observations	264	264	264	264	154	165	154

Notes:
Dependent variable in the regressions is annual MFP growth in post and telecommunications, independent variables are the technology gap of the industry relative to the productivity frontier and barriers to entry in post and telecommunications. *, ** and *** denote a coefficient significantly different from zero at, respectively, 10%, 5% and 1% level. Standard errors, consistent for heteroscedasticity and autocorrelation, are in parentheses.

Table A15, Barriers to entry and other regulation measures in telecommunications

	(1)	(2)	(3)	(4)
Technology gap	0.077***	0.077***	0.078***	0.077***
	(0.023)	(0.023)	(0.022)	(0.022)
Barriers to entry	-0.041***	-0.037***	-0.034***	-0.029**
	(0.012)	(0.013)	(0.012)	(0.013)
Public ownership		-0.002		-0.003
		(0.003)		(0.003)
Market structure			-0.005	-0.006*
			(0.004)	(0.004)

Notes:
Dependent variable in the regressions is annual MFP growth in post and telecommunications, independent variables are the technology gap of the industry relative to the productivity frontier, barriers to entry in post and telecommunications and measures of public ownership and market structure. *, ** and *** denote a coefficient significantly different from zero at, respectively, 10%, 5% and 1% level. Standard errors, consistent for heteroscedasticity and autocorrelation, are in parentheses.