APPENDIX A: STUDY SAMPLE AND MAIN VARIABLES

STUDY SAMPLE

Our study sample is an unbalanced country-industry panel dataset of 2,812 observations from 1987 to 2007, which have assembled from several sources of data, primarily the STAN OECD data base and which we have already used in our two previous studies (Bourlès *et al*., 2013, and Cette, Lopez and Mairesse, 2013). For the purpose of this analysis we had to complete it as mainly concerns the production prices and wages information. It covers fourteen countries (Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, the United Kingdom and the United States) and eighteen industries. We distinguish for the purpose of our analysis two groups of industries delineated mainly for reasons of congruence with the OECD regulation indicators HT and NMR (see Appendix B). The first group we refer as Manufacturing consists of thirteen industries, mostly in manufacturing: food products, textiles, wood products, paper, chemicals products, non-metallic mineral products, metal products, machinery non elsewhere classified.(ne.c.), electrical equipment, transport equipment, manufacturing non elsewhere classified.(ne.c.), as well as construction and hotels & restaurants, which we thought more appropriate to include in this group. The second group comprise five network and service industries: energy, transport & communication, retail distribution, banking services and professional services, which for simplicity we call Non-Manufacturing industries.

MULTI FACTOR PRODUCTIVITY (*MFP*)

Our regression model, referred as (1) in the text, is expressed in terms of *MFP* levels. These levels are calculated for a base year (2000) and then extended over the sample period using data on *MFP* growth calculated as follows (using small letters for logarithms):

$$\Delta\, mfp_{cit} = \Delta\, va_{cit} - \left(\alpha_i .\ \Delta\, l_{cit} + \beta_i .\ \Delta\, c^{I}_{cit} + \gamma_i .\ \Delta\, c^{NI}_{cit} + \Delta\, c^{S}_{cit} + \theta_i .\ \Delta\, k_{cit}\right)$$

where VA_{cit} is the Value Added at constant price of country *c*, industry *i* at time t, L is the total employment in number of workers, C^I, C^{NI} and C^S the physical capital stocks of, respectively, Information and communication technology (*I*), Non-ICT equipment (*NI*) and non-residential Structure (*S*), K the knowledge capital stock and α_i, β_i, γ_i and θ_i the output elasticity of these factors in industry i, approximated by the factor cost shares over total cost in the USA, averaged on the 1987-2007 period for each industry. Remember that regression (1) including country*industry fixed effects, our estimates of the impact parameters of interest are in fact independent of the *MFP* levels and relate only to *MFP* growth rates.

Capital stocks C^I, C^{NI} and C^S and K are calculated from investment data using the so called permanent inventory method, assuming constant geometric rates of depreciation: 5% for non-residential structures, 10% for non-ICT equipment, 20% for ICT equipment and 25% for R&D. In order to compute investments at constant prices, we have used investment deflators at the national level. Because of the lack of specific price information for R&D, we have used as a proxy the manufacturing production deflator. To improve comparability, we have assumed that in all countries for the ICT investments in hardware, software and telecommunications equipment the ratio of investment prices to the GDP price is the same as for the USA. This correction appears indeed as important since the USA is the country that uses most systematically hedonic methods to measure these prices and that the quality improvements have been considerable for these products during the study period.

Data on value added and employment come from the OECD STAN database, data on R&D expenses from the ANBERD OECD database and on physical investments for non-residential structures, non-ICT and ICT equipment from the EU KLEMS database. Since R&D is not yet treated as investment in the national accounts collected by OECD, we had to correct both the industry value added by adding ("expensing out") the intermediate consumption of their R&D activities, and the industry number of employees by subtracting the number of R&D personnel ("avoiding double counting"). Note also that we had to modify the price index of value added, and hence its value at constant prices, for the "Electrical and optical equipment" industry, which includes ICT equipment. We assumed as for ICT investment that in this industry the ratio of value added prices to the GDP price is the same in all countries as for the USA.

The country Box Plots of Figure A1 shows that *MFP* growth rates cannot only be widely varying from year to year and across industries, but that they also differ significantly in average by country, the median *MFP* growth i ranging from 0.35% in Spain and 1.01% in Canada to 2.97% and 4.28% in the Czech Republic.

PRODUCTION PRICE AND WAGE INDEXES

In regression model (1), as explained in section II of the text, we have computed the price indicators of direct and indirect impacts with respect to manufacturing and non-manufacturing: DM_p_{cit}, DNM_p_{cit}, IM_p_{cit} and INM_p_{cit} on the basis of the country*industry production prices indexes to the country GDP price index, which are available in the OECD STAN database. We have computed similarly the low and high-skilled wage indicators of impact: JL_w_{cit} and JH_w_{cit} using the country wage indexes relative to the country GDP price index, which come from the EUKLEMS database. As noted in the text, what we refer as low-skilled indicator JL_w_{cit} is in fact a combination with the medium-skilled indicator, for the of precision of estimation results.

The Bar chart of Figure A2 shows the manufacturing and non-manufacturing sample average annual growth rates of country production prices relative to GDP price. Except for Japan, all these growth rates relative to GDP price growth rate are negative, and quite limited in average per year. We see nonetheless significant differences across countries and a wider relative average decrease for manufacturing than for non-manufacturing industries. Similarly, the Bar chart of Figure A3 shows the sample average annual growth rate of real wages for high-skilled and low-skilled workers. These growth rates are all positive and larger than for the production prices, but also differ markedly across countries in average per year. We also observe they are quite close for the low and high-skilled wages.

VARIANCE ANALYSIS OF MAIN VARIABLES WITH RESPECT TO THE FIXED EFFECTS

We have explained in Section III of the text why, in addition to the necessary inclusion of country*industry fixed effects, we have included country*year fixed effects in estimating regression model (1), and why we did not also include industry*year fixed effects. We also referred to Bourlès et al. (2013) to clarify why these two specifications tend to respectively provide upper and lower range estimates, which can be indeed verified in Table C1 in

Appendix C. One important reason we put forward was the trade-off between exacerbating attenuation biases from errors in variables and correcting for omitted variables and *stricto sensu* endogeneity. Such trade-off mainly depends on the reduction of variability in the dependent and independent regression variables, which is resulting from introducing fixed effects and which can often be massive.

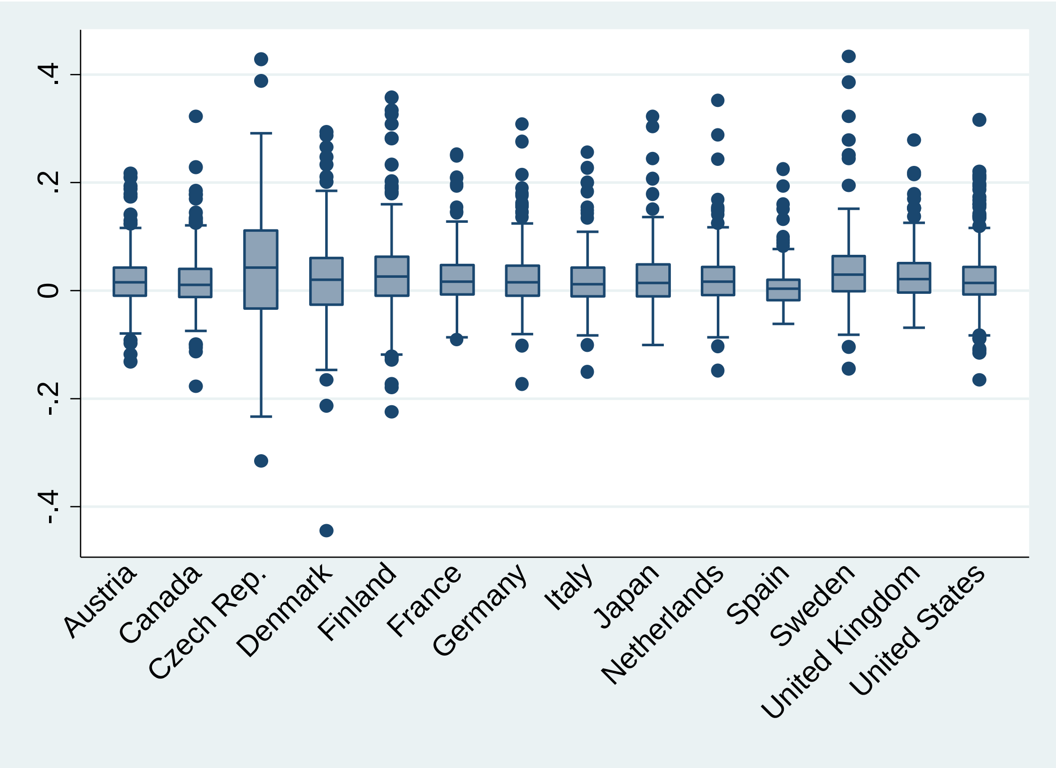
Tables A1 and A2 show in detail how such reduction is increasing with the progressive introduction of fixed effects. The analysis of variance in Table 1 starts from the regression specification in levels with country*industry fixed effects that we privileged. The analysis of variance in Table A2 starts from a specification in first-differences that also control for country*industry fixed effects by first-differencing country*year observations, but is more vulnerable to errors in variables than the fixed effect country*industry or "within country*industry" that we favour.

In both tables, each column gives the residual standard-deviation of the regression on a sequence of fixed effects for each of variables in our analysis. Thus in Table A1, column (1) shows the dispersion if we were including only the country, industry and year fixed effects η_c, η_i, η_t while column (2) shows by how much this dispersion is reduced by also including the country*industry fixed effects η_{ci} (which we have to do since all our variables are computed from country*industry indexes equal to 1 by construction in a given reference year). Columns (3) and (4) document the further reductions in dispersion by including respectively the country*year fixed effects η_{ct} alone, which is our preferred specification, or both the country*year and industry*year fixed effects η_{ct} and η_{it} . We can observe that the residual standard deviations in column (3) are particularly small and that they are even smaller in column (4) for INM_p , the indirect price impact indicator with respect to non-manufacturing, and for JL_w and JH_w , the low and high-skilled impact indicators. This accounts for the relatively large standard errors of the corresponding estimated elasticities of our preferred estimates in column (6) of Table 1 in the text. It also accounts for the significant drop in these elasticities in column of Table C1 of Appendix C, which is probably related to the exacerbation of measurement errors biases.

Estimation in country*industry log first differences may be easier to interpret than estimation in within country*industry log levels, which is what we do in another way by including in the specification of regression (1) the country*industry fixed effects η_{ci} . The columns (1), (2) and (3) of Table A2 thus correspond respectively to the columns (2), (3) and (4) of Table A1.

We can indeed verify that the comparable evidence. Actually when we estimate regression (1) in country*industry log first differences, we obtain estimated elasticities that are not qualitatively different but that tend to smaller and have higher standard errors. In fact within level estimators have the advantage of being less affected by potential measurement errors in variables than estimators in first differences, which why we prefer the former in the present analysis (see Mairesse, 1990).

Figure A1: Country Box Plot of log MFP growth



MFP growth rates= log (MFP_t) –log (MFP_{t-1}) in percent

Figure A2: Sample average annual growth of relative production prices

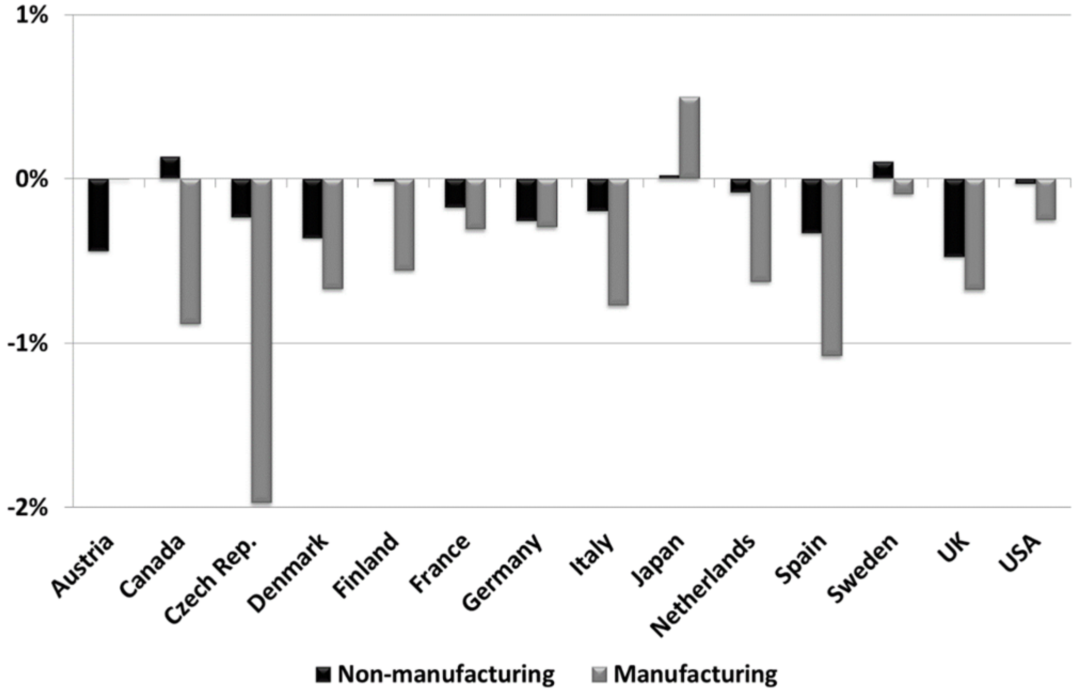


Figure A3: Sample average annual growth of real wages, by skill level

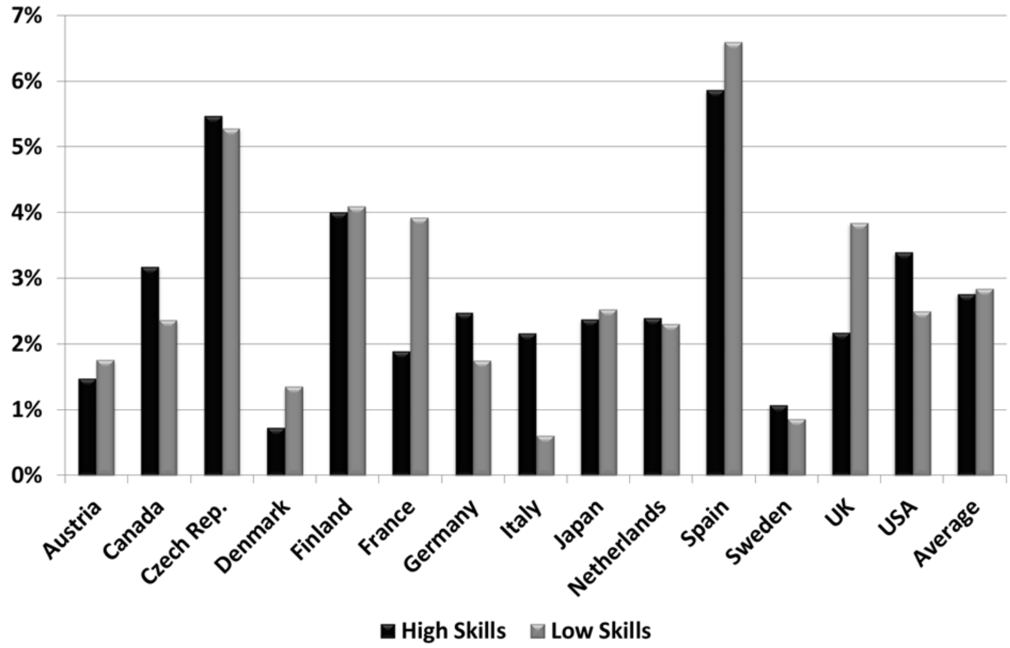


Table A1 : Analysis of variance of the regression variables in log levels controlling sequentially for fixed effects

		(1)	(2)	(3)	(4)
Fixed effects	Country, industry, year	Y	Y	Y	Y
	Country*industry	N	Y	Y	Y
	Country*year	N	N	Y	Y
	Industry*year	N	N	N	Y
MFP (mfp)		0.235	0.162	0.163	0.079
USA MFP (mfp^{US})		0.168	0.160	0.164	---*
Direct prices	Manuf. industries (DM_p)	0.038	0.033	0.067	0.051
	Non-manuf. industries (DNM_m)	0.007	0.007	0.030	0.028
Indirect prices	Manuf. industries (IM_p)	0.080	0.067	0.03	0.019
	Non-manuf. industries (INM_p)	0.042	0.031	0.003	0.002
Country wages * industry labour share	High-Skilled (JH_w)	0.071	0.009	0.007	0.004
	Low-Skilled (JL_w)	0.106	0.015	0.010	0.006
Degree of freedom		2766	2571	2433	2173
Observations		2820	2820	2820	2820

*The variability in (mfp^{US}) is necessarily null when controlling for industry*year fixed effects. Columns (1), (2), (3) and (4) give the standard deviations of the variables after controlling for fixed effects.

Table A2: Analysis of variance of the regression variables in country*industry log differences controlling sequentially for fixed effects

		(1)	(2)	(3)
Fixed effects	**Country*year**	**N**	**Y**	**Y**
	Industry*year	**N**	**N**	**Y**
MFP (mfp)		0.066	0.064	0.052
USA MFP (mfp^{US})		0.058	0.057	---*
Direct prices	**Manuf. industries (DM_p)**	0.030	0.028	0.021
	Non-manuf. industries (DNM_p)	0.018	0.018	0.018
Indirect prices	**Manuf. industries (IM_p)**	0.016	0.011	0.008
	Non-manuf. industries (INM_p)	0.004	0.002	0.002
Country wages * industry labour shares	**High-Skilled (JH_w)**	0.004	0.003	0.002
	Low-Skilled (JL_w)	0.007	0.003	0.003
Degree of freedom		2590	2432	2172
Observations		2591	2591	2591

*The variability in **(mfp^{US})** is necessarily null when controlling for industry*year fixed effects. Column (1) gives the standard deviations of the first difference of the variables, while columns (2) and (3) gives them after controlling respectively for country*year fixed effects and both country*year and industry*year fixed effects.