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Capital's Grabbing Hand? A Cross-Country/Cross-Industry Analysis of the Decline of the Labour Share

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Thomas Manfredi

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SUMMARY

We examine the determinants of the within-industry decline of the labour share, using industry-level annual data for 25 OECD countries, 20 business-sector industries and covering up to 28 years. We find that total factor productivity growth – which captures (albeit imprecisely) capital-augmenting or labour-replacing technical change – and capital deepening jointly account for as much as 80% of the within-industry contraction of the labour share. We also find that other important factors are privatisation of state-owned enterprises and the increase in international competition as well as off-shoring of intermediate stages of the production process. By contrast, we are unable to detect any effect from increases in domestic competition brought about by entry deregulation.

RÉSUMÉ

Nous examinons les déterminants du recul intrasectoriel de la part du travail, en utilisant des données sectorielles pour 25 pays de l'OCDE et 20 secteurs marchands sur une période couvrant jusqu'à 28 années. Nous trouvons que la croissance de la productivité totale des facteurs – qui peut représenter le progrès technique qui augmente la productivité du capital ou remplace le facteur travail – et l'accroissement de l'intensité capitalistique ont représenté ensemble à peu près 80 % de la diminution intrasectorielle moyenne de la part du travail dans les pays de l'OCDE. Nous trouvons aussi que d'autres facteurs importants sont la privatisation des entreprises publiques dans le secteur marchand ainsi que l'accroissement de la concurrence internationale et des délocalisations à l'étranger de la production de biens intermédiaires. Par contre, nous ne pouvons pas détecter un quelconque effet de l'accroissement de la concurrence intérieure résultant de la déréglementation de l'entrée sur les marchés des produits.

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Introduction

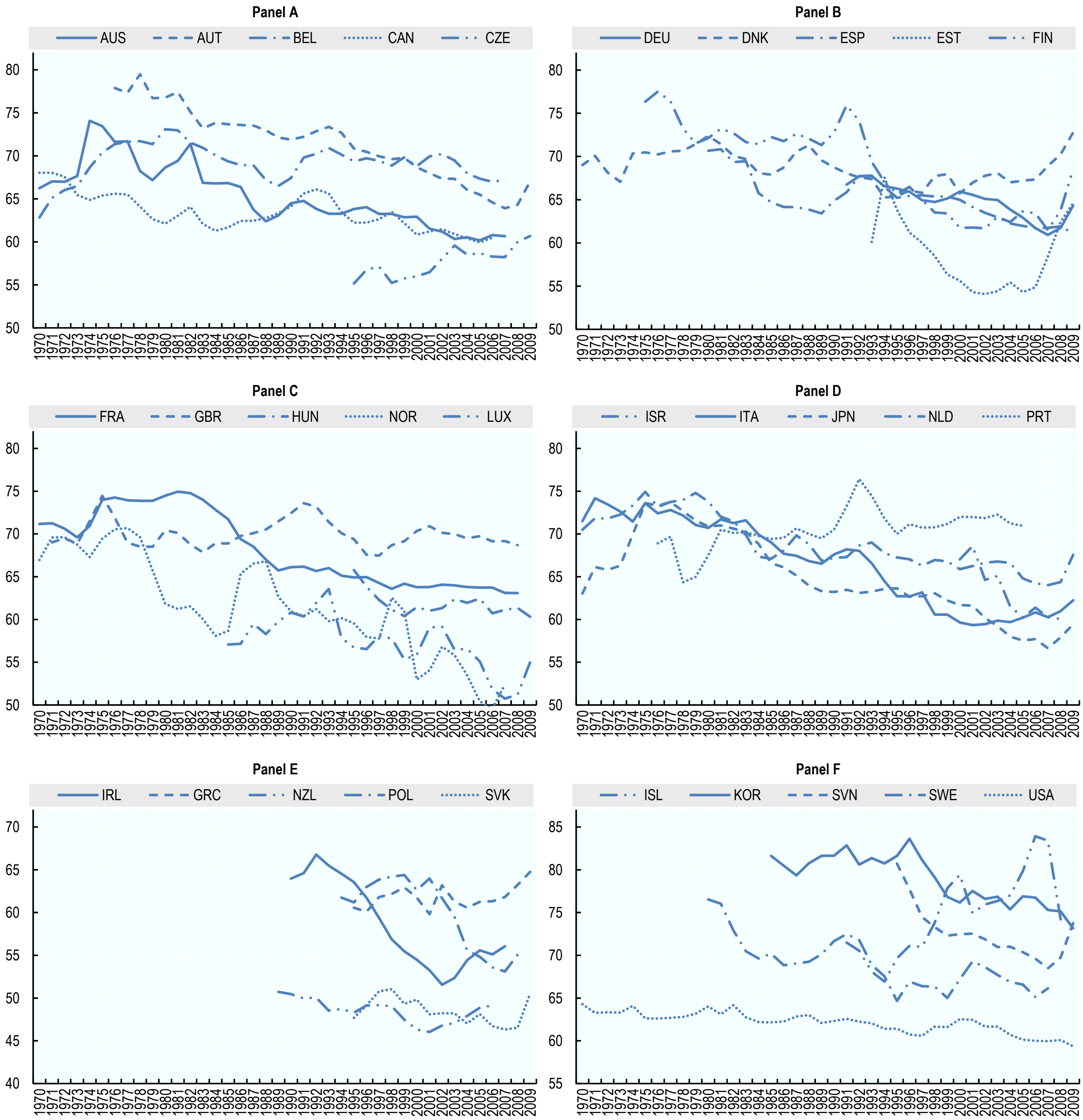
In recent decades, the aggregate labour share – that is the ratio of labour compensation to domestic output – has been declining in OECD countries (Figure 1). Although the pace of the decline differs, this decline is observed in most countries. This contraction typically marks a pause in times of economic recession – the most recent being no exception – but typically resumes with recoveries. Moreover, no qualitatively different picture emerges if one looks at the business sector only (Figure 2) where it can be assumed that the decline of the labour share was due to market forces rather than increasing fiscal discipline. This suggests that workers appropriate an increasingly smaller share of national income.

Should policy-makers be concerned about these developments? In essentially all OECD countries, while the fraction of national income accruing to labour decreased, economic growth was still sufficiently rapid so that real labour compensation increased and workers were on average better off. However, there is evidence that not all workers have fared equally well. Recent work has shown that labour compensation of top income earners, both in private companies and government-controlled enterprises and organisations, has increased dramatically (*e.g.* Saez and Veall, 2005; Atkinson *et al.*, 2011, OECD, 2012), while the position of those at the bottom end of the distribution has been worsening. This has meant that the pre-tax distribution of income has become more unequal in most OECD countries (see, for example, OECD, 2011a). There is a risk that this tendency, coupled with diverging trends between the average labour share and the average capital share, becomes a threat to social cohesion. Moreover, the shift of income away from labour (and, in particular, away from low-wage workers) towards capital (and top earners) might also have a negative impact on aggregate demand, to the extent that workers with below-average pay tend to have a higher consumption propensity than do top earners and capitalists (see e.g. Belke *et al*., 2012).

This paper takes another look at possible determinants of the decline of the labour share. Indeed, several explanations for the decline in the labour share have been put forward in the literature. These include globalisation and outsourcing, increasingly faster labour-saving capital accumulation, skill-biased technical change and privatisation of state-owned enterprises. The contribution of this paper is to assess and quantify the role of all these determinants simultaneously by looking at the within-industry evolution of the labour share using cross-country comparable data, thus controlling for composition effects. In addition, special attention is devoted to endogeneity issues, in particular as regards possible reverse causality and biases due to omitted variables. To anticipate our results we find that TFP growth and capital deepening jointly account for as much as 80% of the within-industry contraction of the labour share in OECD countries between 1990 and 2007. We also find evidence that rising domestic and international competition had a significant but smaller impact on the labour share. In rich countries, at least 10% of the decline of the aggregate labour share is accounted for by increasing globalisation – and in particular by the pressure arising from delocalisation of segments of the production chain and import competition from firms producing in countries with low labour costs. Moreover, the significant trend towards reducing public ownership of companies operating in the business-sector also appears to have been an important determinant of the contraction of the labour share, which might be explained by the impact of privatisations on executives' incentives for profit maximisation. This has been particularly the case in network industries where this process has been of paramount importance. In fact, massive privatisation of network industries since the early 1990 can explain about 33% of the decline of the labour share in these industries. By contrast, we find no evidence that deregulation of inward foreign direct investment (FDI) had any negative impact on the labour share of the deregulating country.

Figure 1. **The aggregate labour share, 1970-2009**

Percentage of GDP

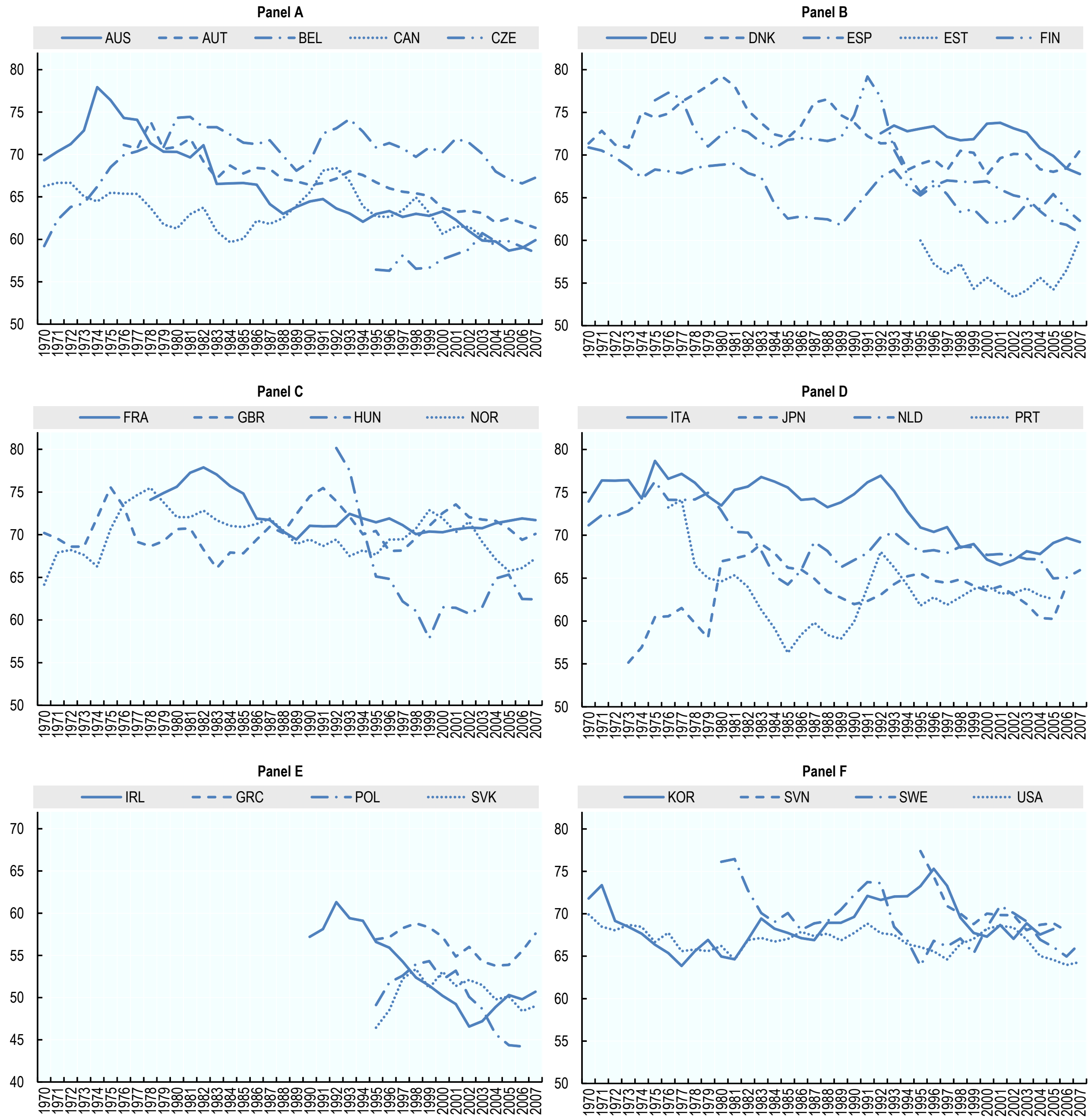


Note: The earnings of the self-employed are imputed assuming that their annual earnings are the same as for the average employee in the whole economy.

Source: EU-KLEMS except for Norway, OECD STAN database.

Figure 2. **The labour share in the business sector, 1970-2007**

Percentage of business-sector's value added



Notes: The data refer to the business-sector excluding agriculture, mining, fuel and real estate. The earnings of the self-employed are imputed assuming that in each industry their hourly earnings are the same as for the average employee in the same industry. Estimates for Norway exclude the chemical industry and are based on average hours per employed person rather than average hours per employee.

Source: OECD STAN database, except for Australia, Belgium, Ireland, Portugal and Sweden, EU-KLEMS.

Recent academic work on the decline of the labour share has pointed to the role of capital accumulation and capital-augmenting technical change (see e.g. Bentolila and Saint-Paul, 2003, Arpaia *et al.*, 2009, Driver and Muñoz-Bugarin, 2010, Raurich *et al.*, 2012). In particular, Bentolila and Saint-Paul

(2003) estimate a specification derived by a standard production function, where a residual measure of efficiency (total factor productivity, TFP hereafter) is included as a noisy (*i.e.* imprecise) proxy of technical change. They find that the growth in capital intensity and TFP have both a negative impact on the labour share[1] and jointly over-predict its aggregate fall in OECD countries between 1972 and 1993. Under standard assumptions, this suggests that the evolution of the labour share have been driven by capital-labour substitutability and capital-augmenting (or even labour-replacing) technical change. This conclusion is confirmed by Arpaia et al. (2009), based on a structural model. They also argue that the high degree of substitution between capital and labour was in fact due to high substitution between capital and low-skilled labour and complementarity between capital and high-skilled labour. Another strand of literature has pointed at the roles of global and domestic competition. In particular, increased import competition has raised competitive pressure on businesses located in the richest countries and the need for them to contain labour costs. Firms and activities unable to remain competitive either downsize and, eventually, disappear or delocalise in countries where relative labour costs appear more favourable. In the face of these pressures, workers might accept to contain their wage claims to save their jobs. There is some scant aggregate evidence which suggests that declines in import prices have contributed to dampen the labour share in high-income countries, due to the fact that imports come increasingly from developing countries, and goods imported from these countries are typically labour intensive (e.g. Harrison, 2002, IMF, 2007, Hutchinson and Persyn, 2012). Aggregate evidence also suggests that offshoring of intermediate input production is negatively related to the labour share, consistent with the evidence that rising global labour supply exerts a negative effect on domestic labour demand (Jaumotte and Tytell, 2007). As regards domestic competition, Azmat *et al.* (2012) find that privatisation of state-owned enterprises in network industries depresses the labour share, while a reduction in barriers to entry increases it, consistent with a standard theoretical model of imperfect product and labour markets with homogenous firms and workers (see, for example, Blanchard and Giavazzi, 2003). We improve on this literature by considering all of these possible factors together and by exploiting the industry dimension of our data, paying particular attention to omitted variables and possible reverse causality.

The paper is organised as follows: Section 1 lays out our empirical strategy; Section 2 briefly describes the data and the sample; and Section 3 presents the empirical results followed by some concluding remarks.

1. Empirical strategy

In a standard aggregative model of the economy, if labour and product markets are competitive, the labour share depends uniquely on capital intensity, the evolution of capital-augmenting technical change and the elasticity of substitution between capital and labour (*e.g.* Acemoglu, 2003, Bentolila and Saint-Paul, 2003). For instance, in the case of a CES production function, we have, in a closed economy, that:

$$F_t = 1 - \alpha (B_t k_t)^{\theta}$$

where B represents capital-augmenting technical change, k capital intensity – that is in the ratio of the volume of capital services to value added – and θ is a function of the elasticity of substitution ρ (ρ=1-1/θ), which is negative when capital and labour are gross substitutes. It can be easily shown, by using a first order Taylor approximation of log(1-*x*) that this leads to:

1 . This is consistent with capital and labour being gross substitutes as found in a number of studies based on aggregate data (see for example Masala and Papageorgiou, 2004). The seminal paper of Berndt (1976) also finds elasticities of substitution greater than 1, although insignificantly. More generally, however, estimated elasticities of substitution reported in the literature can vary from significantly smaller to significantly larger than 1 (see e.g. Antras, 2004).

$$F_t \cong Const + \theta \log B_t + \theta \log k_t \qquad [1]$$

that can be used as a baseline to estimate the determinants of the labour share at the aggregate or industry-level. Interestingly, [1] implies that the more capital is a gross substitute for labour and the more capital intensity and capital-augmenting technical change will depress the labour share. If labour and product markets are not competitive, competition and labour market institutions (including workers' bargaining power) will act as shifters of this relationship (see *e.g.* Hutchinson and Persyn, 2012). In addition, cyclical fluctuations in union bargaining power, due for example to unemployment fluctuations, can cause additional departures from this relationship. This implies that the role of these factors can in principle be studied by including additional covariates.

While *k* is observable in [1] – although with some error – *B* is not, however. Nevertheless, as suggested by Bentolila and Saint-Paul (2003), one can approximate *B* with a measure of total factor productivity (TFP), which is supposed to capture both capital and labour augmenting technical change. Indeed, insofar as the latter has no theoretical impact on *F* conditional on *k*, the estimated coefficient of TFP should give an indication of the direction and intensity of the impact of *B*. Obviously, the larger the proportion of neutral or labour augmenting technical change and the less adequate is TFP as a proxy of capital augmenting technical change, and therefore the greater the bias towards the origin of its coefficient in estimated versions of [1].

The key difficulty with this approach, however, is that *k* and *B* are endogenous. For example in the model of directed technical change by Acemoglu (2003), the incentives to innovate depend on the share of income paid to each factor, so that a decrease in the labor share encourages capital-augmenting technological change. Since, as in a standard growth model, there is no obvious instrument for *k* and *B*, a natural solution, adopted in this paper when possible, is using dynamic GMM estimators.

Bentolila and Saint-Paul (2003) estimate an extended version of [1] – using industry-level data and GMMs as in this paper and including country-by-industry fixed effects (but no time effect). They find that the evolution of the labour share is explained essentially by TFP and capital-intensity, both with negative coefficient, which would suggest that, in the sample period, capital and labour have tended to be gross substitutes and technical change capital augmenting. However, one of the problems of Bentolila and Saint-Paul's estimates is the unsatisfactory number of co-variates used to capture aggregate institutions and cyclical fluctuations. Other models have in fact included a larger number of institutions and aggregate unemployment rates to capture aggregate shifts in [1] (*e.g.* De Serres *et al.*, 2002). The reason why few controls are included in Bentolila and Saint-Paul's model comes from the fact that GMM estimators become unstable when the number of covariates increases (or more precisely when the number of instruments trespasses the number of groups). In order to keep the model tractable with GMM estimators, country-by-time effects are systematically included to control for all aggregate variables, thereby avoiding the inclusion of a large number of them in the specification. As it is typically difficult to write an exhaustive list of aggregate institutions and factors affecting the labour share, this represents also a further advantage with respect to standard aggregate estimates (*e.g* .Jaumotte and Tytell, 2007, Checchi and Garcia-Peñalosa, 2010, Azmat *et al.*, 2012, Hutchinson and Persyn, 2012). This implies that the estimated specifications would take the form:

$$F_{ijt} = \beta \log TFP_{ijt} + \gamma \log k_{ijt} + X_{ijt}\delta + \eta_{ij} + \eta_{it} + \varepsilon \qquad [2]$$

where *TFP* stands for a measure of level TFP whose changes can noisily proxy for capital-augmenting technical change, *X* is a vector of other labour-share determinants and controls that vary by country *i*, industry *j* and time *t*, η are country-by-industry and country-by-time effects, ε is an error term and other Greek letters are parameters to be estimated.[2]

Equation [2] is typically estimated here using dynamic GMM estimators. As standard in the dynamic GMM literature (*e.g.* Felbermayr *et al.*, 2011) de-meaning by subtracting country-by-time averages from the data is used to implement this control while avoiding increasing the number of covariates. However, insofar as dynamic GMM estimators can be highly inefficient (and therefore strongly biased in small and medium samples) comparisons with standard fixed effects models will however be key, and fixed effect estimates are preferred for inference when endogeneity biases appears negligible. Indeed, the consistency between types of estimates would be reassuring on their reliability.

The vector of determinants *X* often contains variables that are available or defined on a different sample (see the next section). For example trade variables are typically reliable only in manufacturing, while product market competition is available only for network industries. In addition, certain trade indicators, derived from input-output tables, are not available on an annual basis. This implies that GMM estimations could be unfeasible, for example because the number of instruments would be too large with respect to the number of groups. In this case, two alternative strategies are followed. If the variables of interest can be considered as *prima facie* exogenous, then simple static fixed effects on annual data are used. This is the case, for example, of regulatory variables. However, we check the consistency of estimated coefficients of other variables, such as capital intensity and TFP, which in these specifications are included only as controls, with GMM estimations, typically performed on a larger sample, in which these variables are treated as endogenous. If exogeneity of interesting variables cannot be assumed, or annual data are not available, equation [2] is reformulated in five-year differences, thereby eliminating fixed effects, while ensuring that estimated coefficients are not entirely driven by short-term variation. Then key, potentially endogenous variables are lagged one period (five years). In such a way, potential reverse causality, often the most serious reason to worry about endogeneity, is taken care of.

2. The data

The labour share is typically computed by dividing gross labour compensation by gross value added at current basic prices.[3] In many industries outside the business sector, however, the measurement of value added is problematic. For example, the value added of the public administration, as measured in the national accounts is often equal to the sum of labour costs. As a consequence, the labour share is often dramatically inflated in the public sector. Conversely, in industries such as mining and fuel production, value added fluctuates quite a lot subject to changes in world demand for raw materials, while wages do not, thereby inducing large fluctuations in the labour share. Another source of measurement error is the imputation of owner-occupied housing in the national accounts, which is a significant proportion of value added in the real estate industry but is only reported as capital income (see *e.g.* OECD, 2009). Finally, the revenue of the self-employed is a mix of capital and labour income, which are typically not identified separately in the national accounts. There is a wide consensus that the remuneration of proprietors' labour should be assumed to be equal to the average compensation of wage earners (Gollin, 2002; Arpaia *et al.*, 2009). Typically, due to data availability, average annual wages of the whole economy are used for this calculation. However, the share of self-employed varies significantly across industries as does average

2 . The disadvantage of the approach adopted here is that it does not allow identifying the effect of aggregate institutions.

3 . Value added at basic prices is calculated from the value of output plus subsidies on products less the purchases of goods and services (other than those purchased for resale in the same condition) plus or minus the change in stocks of raw materials and consumables less other taxes on products which are linked to turnover but not deductible.

compensation of employees, therefore imputation rules based on average compensation in the whole economy can be misleading both in terms of levels and trends.

In order to address these issues, in this paper we focus on the labour share in the non-agricultural/non-mining/non-fuel/non-real-estate business sector – accounting for about two-thirds of the whole economy – where most of these problems are likely to be less important. In addition, following Arpaia *et al.* (2009), we impute the income of the self-employed on the basis of the average hourly wage of each industry. For this purpose we use comparable data from EUKLEMS, except for Norway, whose data (source OECD STAN) are added to Figure 2 only for the purpose of comparison (see the Appendix for more details on sources).

Our industry-level labour share data cover a sample of 21 disaggregate industries (at an intermediate level between 1 and 2 digits of the ISIC rev.3 classification; see the next section for the detailed list) in 25 countries (see Figure 2 above), which can be followed for up to 38 years (1970-2007). However, in practice, in most of our specifications, availability and/or reliability of data of particular controls severely limit the size of the sample. For example, sufficiently long cross-country comparable annual time-series of TFP levels are available only for 13 countries[4] and are typically unreliable in financial intermediation and business services (see Bassanini *et al.*, 2009, for an in-depth discussion of this issue). As a consequence, in specifications including TFP levels and capital intensity, we limit our samples to these countries and industries. For similar reasons of reliability, we limit our analysis to the period after 1980.

Data on industry output, capital services and productivity are from EUKLEMS and associated databases. By contrast, most trade variables are from OECD STAN (import penetration and trade exposure) or OECD (2008) and are restricted to manufacturing industries for which long time series are available. Data on intra-industry offshoring (defined as the value of imported same-industry inputs to that of domestic output, both derived from OECD Input-Output Tables) are the only exception. However, they are available for only three years (1995, 2000 and 2005). By contrast, annual data are available for indicators of public ownership and regulatory barriers to entry (source: OECD regulatory database), but only for three network industries (electricity, gas and water; transports; and communications). These indicators vary from 0 to 6 from least to most restrictive levels of regulations. Descriptive statistics and detailed data definitions and sources are available in the Appendix.

3. Empirical results

Capital-intensity and technical change

We start our analysis by estimating a baseline model of the relationship between capital intensity, TFP growth and the dynamics of the labour share (Table 1), which are available for most industries and will be used as controls in virtually all specifications presented in this paper. Panel A reports the results for specifications including a summary measure of capital intensity (defined as the ratio of capital services to value added). Panel B reports estimates for models in which capital intensity is split between its ICT capital and non-ICT capital components. For brevity, only the coefficient of the lagged dependent variable and long-run coefficients are reported in dynamic models.

4. Australia, Austria, Belgium, Denmark, Germany, Finland, France, Italy, Japan, the Netherlands, Spain, the United Kingdom and the United States.

Table 1. **Capital intensity, TFP and the labour share**

Panel A. Total capital

	(1) Dyn OLS	(2) FE	(3) DFE	(4) GMM-Diff	(5) GMM-Sys	(6) GMM-Sys collapsed IVs
Lagged labour share	0.945***		0.816***	0.742***	0.856***	0.794***
	(165.05)		(57.632)	(19.803)	(33.874)	(18.281)
Log TFP	-0.225***	-0.140***	-0.217***	-0.579***	-0.167***	-0.351***
	(8.346)	(-12.428)	(7.541)	(3.943)	(3.706)	(4.799)
Log Capital intensity	-0.238***	-0.054***	(-0.056)***	-0.179**	-0.150***	-0.140***
	(11.817)	(-5.425)	(1.985)	(2.117)	(3.350)	(2.829)
Observations	5697	5944	5697	5450	5697	5697
R-squared	0.956	0.861	0.959			
countryXindustry FE	no	yes	yes	yes	yes	yes
countryXtime dummies	yes	yes	yes	yes	yes	yes
Arellano-Bond AR1 test				-8.63	-8.08	-9.04
Arellano-Bond AR2 test				-0.18	-0.39	-0.33
Hansen test (P-value)				0.17	0.45	0.39

Panel B. ICT e non-ICT capital

	(1) Dyn OLS	(2) FE	(3) DFE	(4) GMM-Diff	(5) GMM-Sys	(6) GMM-Sys collapsed IVs
Lagged labour share	0.949***		0.816***	0.736***	0.869***	0.799***
	(176.285)		(57.228)	(19.266)	(34.236)	(18.426)
Log TFP	-0.227***	-0.145***	-0.232***	-0.676***	-0.225***	-0.374***
	(7.570)	(-11.593)	6.991247	(3.839)	(3.444)	(4.448)
Log ICT Capital intensity	-0.046***	0.009***	-0.009	-0.037	0.0358*	-0.017
	(3.935)	(2.805)	(0.942)	(1.168)	(1.760)	(0.616)
Log Non-ICT Capital intensity	-0.191***	-0.069***	-0.056*	-0.220*	-0.226***	-0.151
	(7.840)	(-5.626)	(1.674)	(1.625)	(3.408)	(1.357)
Observations	5697	5944	5697	5450	5697	5697
R-squared	0.956	0.861	0.959			
countryXindustry FE	no	yes	yes	yes	yes	yes
countryXtime dummies	yes	yes	yes	yes	yes	yes
Arellano-Bond AR1 test				-8.61	-8.13	-9.20
Arellano-Bond AR2 test				-0.17	-0.39	-0.34
Hansen test (P-value)				0.31	0.99	0.19

Notes: The dependent variable is the industry labour share, expressed as ratio of labour compensation to value added. Only long-run coefficients and the coefficient of the lagged dependent variable (if included) are presented. Estimation methods in column titles. All covariates are treated as endogenous in GMM estimations. Levels of dependent and endogenous variables lagged twice and three times are used as instruments in the difference equation. Lagged differences of the same variables are used as instruments in the level equation. In column 6, instruments are invariant across years. Robust t-statistics in parentheses. ***, **, *: significant at the 1%, 5% and 10% level, respectively.

As a benchmark, the first column in both panels reports estimates of a dynamic OLS specification in which country by industry heterogeneity and persistence patterns are controlled for through a lagged dependent variable. Column 2 reports results from a static fixed-effect (FE) model where country-by-industry dummies are included and the lagged dependent variable excluded. The lagged dependent variable is re-included in Column 3 through a dynamic fixed-effect specification (DFE). Differences across these estimates suggest that the estimated coefficient of the lagged dependent variable also suffers from endogeneity bias. Column 4 to 6 report different dynamic GMM estimates in which the structure of lags of different endogenous variables is used to generate instruments. Column 4 reports results from difference

GMM estimators (see Arellano and Bond, 1991), in which differences of endogenous variables are instrumented with their levels lagged two and three years. Column 5 reports results from system GMM estimators (see Blundell and Bond, 1998), in which a level equation is added together with an additional set of moment conditions implying that levels of endogenous variables are instrumented with their lagged difference. The validity of the moment conditions is tested through Arellano-Bond tests of serial correlation – the identification assumptions implying that first-difference residuals be significantly correlated over time at one and only one lag – and Hansen tests of overidentification. However, since these two estimators use a different set of instruments for each year,[5] which for the difference equation results in 154 instruments in Panel A and 205 instruments in Panel B for 231 groups, one might worry that the power of the Hansen test could be excessively weakened.[6] For this reason, in Column 6, system GMM estimates are replicated with a collapsed set of instruments, in which the same instrumental variables are used in each period (reducing to 10 and 13 the number of instruments in Panels A and B, respectively).

Column 1 to 3 of Panel A shows a negative within-industry association between both TFP and capital intensity and the labour share. An increase of capital intensity by 1% appears to induce a reduction in the labour share by 0.05 to 0.24 percentage points, while an increase in TFP by 1% is associated with a reduction in the labour share comprised between 0.14 and 0.23 percentage points. Difference GMM estimates suggest a much larger effect of TFP. However, to the extent that the true value of the coefficient of the lagged dependent variable is probably between those estimated in OLS and DFE specifications (see Angrist and Pischke, 2009), one can conclude that there is a large degree of persistence. Under this condition, difference GMM estimates are likely to be much inefficient and system GMMs (in Column 5) are preferable. System GMM estimates appear slightly greater but relatively close to those obtained in standard static FE specifications (cf. Column 2). As a result, one can conclude that FE yield conservative estimates. As shown in Figure 3, these estimates also appear to be reasonably robust to the elimination of either countries or industries one-by-one from the sample.[7] Taking point-estimates of FE specifications at face value, the rise in TFP (about 1.3% per year between 1990 and 2007) could account for as much as 66% of the decline in the labour share (0.26 percentage points per year), while 16% of that would be explained by the increase in capital intensity (0.8% per year).

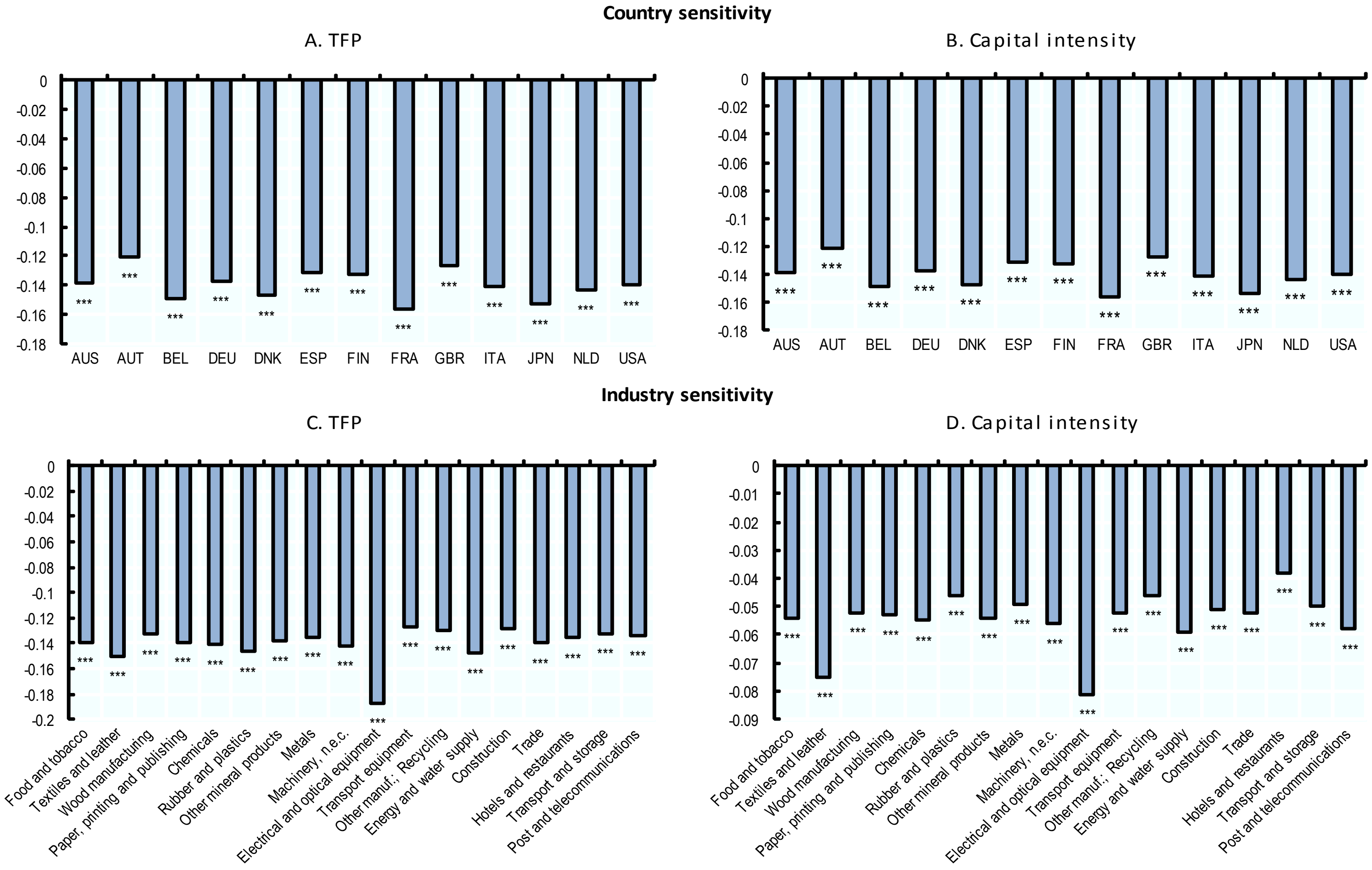
5 . In standard dynamic GMMs, each instrument takes the value of the lagged level or difference of one variable, in one given year, and zero in all the others.

6. The standard rule of thumb is that the number of instruments should be smaller than the number of groups. Although this rule is not violated, the number of instruments for Panel B is quite close to the threshold.

7 . Checking robustness to excluding countries one-by-one is important given the small sample of countries. As quality-adjusted deflators for value added have decreased enormously in a couple of industries, it is also important to check that the coefficient for TFP is not entirely due to these industries.

Figure 3. **Sensitivity of the effect of capital intensity and TFP on the labour share to countries and industries in the sample**

Point-estimates of the effect of capital intensity and TFP once the indicated countries/industries are excluded from the sample



Notes: Coefficients obtained by re-estimating the specification of Column 2 of Table 1, excluding the indicated country or industry. ***: Significant at the 1% level.

Slightly different results also emerge from specifications in which the effect of capital intensity is allowed to differ between ICT and non-ICT capital (Table 1, Panel B). While the estimated coefficient of TFP is about the same, the negative effect of capital intensity indeed appears to be confined only to non-ICT capital, while ICT capital appears to have a modest but positive impact on the labour share in both FE and system GMM estimates. However, caution is required in interpreting these estimates. To the extent that, after netting out the contribution of aggregate factors, within-industry changes in ICT and non-ICT capital intensity are extremely correlated (with a correlation coefficient of 0.57), a margin of uncertainty exists about point estimates (as reflected by the instability of the estimates for ICT capital across specifications).

Including hourly labour productivity instead of TFP and capital intensity in the specification yields consistent results (Table 2).[8] Using labour productivity has the advantage that the sample can be extended to the other countries, for which comparable labour productivity data in levels are available. However, the Hansen test statistic, tend to be significant, casting doubts on the validity of the moment conditions for the GMMs. The best system-GMM specification entails using the same moment conditions as for Table 1 and extending the sample only to Canada and a few additional years for Australia. Yet, even in this case, the Hansen statistic is significant at the 10% level, suggesting that the model is mis-specified when labour productivity is included instead of TFP and capital intensity.

Table 2. **Labour productivity and the labour share**

	(1) Dyn OLS	(2) FE	(3) DFE	(4) GMM-Sys
Lagged labour share	0.933***		0.753***	0.843***
	52.15777		(23.417)	(31.169)
Log Labour productivity	-0.135***	-0.108***	-0.155***	-0.193***
	(11.454)	(-18.303)	(8.351)	(6.702)
Observations	9630	10116	9630	6462
R-squared	0.935	0.841	0.941	
countryXindustry FE	no	yes	yes	yes
countryXtime dummies	yes	yes	yes	yes
Arellano-Bond AR1 test				-9.14
Arellano-Bond AR2 test				-0.93
Hansen test (P-value)				0.08

Notes: The dependent variable is the industry labour share, expressed as ratio of labour compensation to value added. Only long-run coefficients and the coefficient of the lagged dependent variable (if included) are presented. Estimation methods in column titles. All covariates are treated as endogenous in GMM estimations. Levels of dependent and endogenous variables lagged twice and three times are used as instruments in the difference equation. Lagged differences of the same variables are used as instruments in the level equation. Robust t-statistics in parentheses. ***, **, *: significant at the 1% level.

The easiest interpretation of these results is that the diffusion of the ICT-general purpose technology have induced a period of strong capital-augmenting technical change with high substitution between capital and labour. This conclusion is confirmed by the findings of Arpaia *et al.* (2009), who suggests that the high

8 . These results are consistent with findings of Guscina (2006) and Hutchinson and Persyn (2012), who find a negative long-run impact of productivity in aggregate cross-country estimates when the sample is restricted to the IT era.

degree of substitution between capital and labour is in fact due to high substitution between capital and low-skilled labour and complementarity between capital and high-skilled labour.[9]

In order to shed further light on this issue, [2] is estimated by taking the relative shares by level of education as dependent variable.[10] In this case equation [2] can be considered as emerging from a second-order approximation of a translog production function where constant returns to scale are imposed, capital is considered as a quasi-fixed factor and relative wages are taken as invariant across industries in the short-run (as *e.g.* in Berman *et al.*, 1994). Results based on GMM estimates[11] suggest that the share of the least educated workers in labour compensation is negatively associated with labour productivity (Table 3, column 1). The effect appears to be particularly strong for workers with less than upper secondary education (cf. columns 3 and 5). However, caution is required in interpreting these results since Hansen tests cast doubts on the validity of the identification restrictions (as in Table 2).

By contrast, specification tests do not reject identification restrictions when the model is refined by disaggregating labour productivity growth into the contributions of TFP growth and the accumulation of ICT and non-ICT capital. Estimates of this model suggests that the share of those with less than tertiary education is negatively affected by both TFP growth and ICT capital (although the effect of the latter is insignificant), consistent with the hypothesis that technological change was skill-biased during the period of analysis (Column 2). Interestingly, the share of those with exactly upper secondary education is negatively affected by TFP growth and positively affected by ICT capital accumulation (Column 6), while that of those with less than upper secondary education is negatively affected by ICT capital intensity (and insignificantly so by TFP growth, Column 4). This suggests that, in the period under analysis, technical change embodied in ICT capital is strongly-biased against the unskilled, while disembodied technical change is strongly skilled-biased. While the first result is classical from the literature on skill-biased technical change and suggests some sort of machine-replacing-unskilled-labour technical change, the latter can be easily interpreted if disembodied technical improvements reflects embodiment in intangible capital (entrepreneurship, output from R&D departments, ideas of high-ranking managers, high-performing human resource practices), that is improvements that are essentially incorporated in highly-qualified personnel.

9 . However these results could also be consistent with other (and more adverse to labour) forms of technical change (such as machine-replacing-labour technical change, see Acemoglu, 2011, Brynjolfsson and McAfee, 2011)

10 . Due to data limitations, this can be done only for fewer countries and years and with more noisy data, particularly as regards manufacturing. In fact, for the partition of industries for which TFP data and data on capital intensity are available or can easily be aggregated, data on labour compensation by levels of education in EU KLEMS are often the result of interpolations and estimations based on debatable assumptions. As a consequence, results in Table 3 must be taken with a lot of caution.

11. Fixed-effect estimates (not shown in Table 3 for brevity) yield always insignificant coefficients. This suggests that system GMM estimates are preferable, at least when specification tests are satisfactory (that is in Column 2, 4 and 6 of Table 3).

Table 3. **Productivity, TFP, capital intensity and the share of the low/medium educated in labour compensation**

	(1)	(2)	(3)	(4)	(5)	(6)
	Upper secondary education or less		Less than upper secondary education		Upper seconday education	
Lagged dependent variable	0.842***	0.929***	0.950***	0.948***	0.804***	0.913***
	(22.999)	(41.579)	(52.878)	(66.135)	(20.098)	(37.376)
Log Labour productivity	-7.893***		-5.255***		-3.647**	
	(4.434)		(2.513)		(2.121)	
Log TFP		-7.632**		1.222		-7.028***
		(2.096)		(0.363)		(2.427)
Log ICT Capital intensity		-0.909		-4.711**		4.062*
		(0.425)		(1.976)		(1.637)
Log Non-ICT Capital intensity		0.099		-1.172		-1.079
		(0.030)		(0.299)		(0.390)
Observations	3024	2730	3024	2730	3024	2730
countryXindustry FE	yes	yes	yes	yes	yes	yes
countryXtime dummies	yes	yes	yes	yes	yes	yes
Arellano-Bond AR1 test	-6.46	-5.52	-5.80	-5.68	-7.52	-6.51
Arellano-Bond AR2 test	0.80	-0.10	1.43	1.38	1.76	1.13
Hansen test (P-value)	0.06	0.91	0.00	0.91	0.04	0.90

Notes: The dependent variable is the share of each group as a percentage of labour compensation. Estimates obtained using system GMM estimators. Only long-run coefficients and the coefficient of the lagged dependent variable are presented. All covariates are treated as endogenous in GMM estimations. Twice-lagged levels of dependent and endogenous variables are used as instruments in the difference equation. Lagged differences of the same variables are used as instruments in the level equation. Robust t-statistics in parentheses. ***, **, *: significant at the 1%, 5% and 10% level, respectively.

International competition, outsourcing and foreign direct investment

What are the consequences of globalisation on trends in the labour share in OECD countries? As discussed in the introduction, scant aggregate evidence suggests that declines in import prices have contributed to dampen the labour share in high-income countries, since imports that come increasingly from developing countries are typically labour intensive. Industry-level estimations performed for this paper, however, do not confirm that increasing competition from abroad-producing firms in domestic markets played a significant role in the *within-industry* decline of the labour share. Table 4 presents, for manufacturing industries, where trade data are more reliable, estimates of [2] augmented by import-weighted industry-specific real exchange rates. For a given industry and country, an increase in this indicator captures a real depreciation in the price of output produced by the industry relative to the country's trading partners (weighted by import shares). Put it another way, an increase in the industry-specific exchange rate represents an improvement in the terms of trade in the industry for the country, thereby reducing foreign competition. This indicator has two advantages. First, changes in real exchange rates are important determinants of cross-industry differences in how the relative intensity of foreign competition changes. Second, and perhaps more important, standard measures of foreign competition based on import quantities are likely to be endogenous to changes in foreign and domestic demand conditions. By contrast, the industry-specific exchange rates is unlikely to be so, provided that country-by-time dummies are included in the specification, since it is the product of an aggregate variable (the exchange rate) and an industry-level variable (the import weights) that does not vary over time (see Bertrand, 2004, OECD, 2007).[12]

Table 4. **Competition from abroad-producing firms and the labour share**

Method	(1) FE	(2) FE	(3) FE	(4) GMM-Sys	(5) GMM-Sys	(6) GMM-Sys	(7) GMM-Sys
Industry-specific exchange rate	0.029	0.053	0.023	0.283*	0.092		
	(0.855)	(1.560)	(0.662)	(1.676)	(0.866)		
Import penetration						0.063	
						(1.000)	
Trade exposure							0.019
							(0.574)
Labour productivity		-0.132***		-0.125***			
		(-10.183)		(-3.240)			
TFP			-0.158***		-0.153***	-0.178***	-0.178***
			(-10.434)		(-2.946)	(-4.631)	(-4.531)
Capital intensity			-0.058***		-0.133***	-0.142***	-0.144***
			(-4.321)		(-2.691)	(-2.617)	(-2.692)
Observations	4,958	4,958	3,110	3,279	2,931	2,643	2,643
R-squared	0.812	0.827	0.856				
Arellano-Bond AR1 test				-7.09	-6.77	-6.36	-6.34
Arellano-Bond AR2 test				-0.55	-0.11	-0.03	-0.02
Hansen test (P-value)				0.26	0.20	0.22	0.24
countryXtime dummies	yes	yes	yes	yes	yes	yes	yes
CountryXindustry FE	yes	yes	yes	yes	yes	yes	yes

Notes: Manufacturing only. The dependent variable is the industry labour share, expressed as ratio of labour compensation to value added. Import penetration: ratio of imports to apparent demand. Trade exposure: rate of the sum of import penetration and export orientation, defined as the ratio of exports to domestic output. Only long-run coefficients are presented. Estimation methods in column titles. All covariates, except the industry-specific exchange rate, are treated as endogenous in GMM estimations. Twice and three-times lagged levels of the dependent variable, productivity, TFP and capital intensity as well as changes in industry-specific exchange rates are used as instruments in the difference equation. Lagged differences of the same variables plus levels of the industry-specific exchange rate are used as instruments in the level equation. Robust t-statistics in parentheses. ***, **, *: significant at the 1%, 5% and 10% level, respectively.

The industry-specific real exchange rate is estimated to be positively associated with the labour share of the industry, as one would expect if a decrease in the price of imports with respect to domestic products, by raising competitive pressure in the industry, would reduce the labour share. However, this relationship is almost never significant. In particular, Column 1 to 3 of Table 4 shows estimates obtained with static fixed effects models both without controls (except for double dimensional dummies) and controlling for, alternatively, labour productivity or capital intensity as well as TFP. Colums 4 to 5 repeat the estimation using dynamic GMM estimators, where the import-weighted industry-specific real exchange rate is treated as exogenous and the other covariates as endogenous. Only in Column 4 a significant coefficient for the exchange rate is estimated. As a robustness check, Column 6 and 7 re-estimate the most structural specification (including TFP and capital intensity) by substituting, alternatively, import penetration (the ratio of imports to apparent demand) and trade exposure for real exchange rates, treating these variables as endogenous and using real exchange rates as an additional instrument.[13] The estimates confirm previous

12. OECD (2007) finds that, in conditional labour demand models, falls in this variable exert a negative impact on labour demand.

13. As these alternative measures of foreign competition are clearly endogenous, fixed effect estimates are likely to be inconsistent and are, therefore, not estimated.

findings. Indeed, not only are coefficients on measures of foreign competition insignificant in these specification, but their sign is opposite with respect to expectations.[14]

How can these results be reconciled with those based on aggregate data? Indeed, using aggregate data, IMF (2007) and Jaumotte and Tytell (2007) both find that a decline in relative import prices has a negative causal effect on the aggregate labour share. One possible explanation has to do with the possible impact of foreign competition on the pattern of reallocation between high-labour-share and low-labour-share industries (that is, on the between component in the shift-share analysis). Indeed, in rich countries one would expect that increased import penetration in one given industry– brought about by fiercer competition from abroad-producing firms relying on lower labour costs – prompted reallocation of resources away from that industry and towards either other domestic industries or countries with lower labour costs. In other words, one would expect import penetration to be related to a contraction of the share of the industry in total value added.

To examine the relationship between import competition and the industry-share in total value added, the following specification is estimated (in 5-year differences) over the period 1982-2007:

$$\Delta \log S_{ijt} = \beta \Delta M_{ijt-5} + \Delta X_{ijt}\delta + \eta_{ij} + \eta_{it} + \eta_{jt} + \varepsilon_{ijt} \qquad [3]$$

where S stands for the share of the industry in nominal value-added, M is import penetration, Δ stands for 5-year differences, X is a vector of confounding factors and the ηs represent double-dimensional dummies. Country-by-time dummies control for all aggregate effects, while country-by-industry dummies and industry-by-time dummies are alternatively included to capture different stages in industry life-cycles. In fact, the evolution of industry shares is closely related to their degree of maturity, with young industries expanding and old industries contracting. Failing to control for these trends can severely bias the estimates. In turn, however, the presence of two sets of double dimensional dummies makes dynamic GMM estimation unfeasible (as it would imply employing an excessively large number of instruments). As a consequence, in order to avoid estimates being biased by reverse causality, which is the most obvious reason for endogeneity in this context,[15] long differences are used and changes in import penetration are lagged once.

The advantage of using a log-linear specification such as [3] is that estimated coefficients can be interpreted as capturing the impact of independent covariates on the share S of industry j in total value added, whatever the subset of industries over which total value added is computed. In fact, $\log S_{ijt} = \log VA_{ijt} - \log \overline{VA}_{it}$, where VA is nominal value added and the bar indicates aggregation across industries. Therefore, estimates will be invariant to the choice of the dependent variable, provided that $\log \overline{VA}$ is controlled for in [3], which is the case because it is collinear to country-by-time dummies. Being the sample confined to manufacturing industries, this is an important advantage since it is not obvious whether the denominator of S should be the value added of manufacturing, the business sector or the total economy.

14 . Results do not differ if the sample is split between high and low-wage countries (see below).

15. For example, certain industries might contract in certain countries for reasons of technological specialisation. If domestic demand does not simultaneously fall, import penetration will increase to satisfy this demand, but this shift corresponds to no real increase in competitive pressure.

Controlling only for relative output prices and industry-by-time and country-by-time dummies, Column 1 in Table 5 shows a negative association between import penetration and the fall in industry value added. Yet, this relationship is not statistically significant. However, even if the sample is composed by typically high-wage countries, there is a significant fraction of them with a relative labour cost advantage with respect to the richest countries. For these countries, import penetration is probably the result of foreign direct investment from multinational enterprises and closer integration with global markets, which rather brings about output expansion. As a consequence, estimates in Column 1 are likely to be affected by a problem of parameter heterogeneity. There is no obvious way to separate high from low-labour cost countries with the data at hand. As a rough classification, in this paper, low-wage countries are identified as those where average gross hourly wages in purchasing power parity were below 50% of the US wage rate in 1997.[16] Column 2 presents the results obtained by excluding low-wage countries.[17] The estimates suggests in this case that an increase in import penetration by 1 percentage point in one given industry would result in a contraction of the share of that industry in value added by 0.2% five years later, a small but statistically significant effect.

One might worry that, due to increasing specialisation, certain industries of certain countries might be on a steady downward trend for output but not for domestic demand so that import penetration would be on a steady upward trend in these industries to satisfy that demand. If this were the case, estimates in Columns 1 and 2 might simply capture this trend. In order to check that this is not the case, Columns 3 and 4 include country-by-industry dummies instead of industry-by-time dummies (in practice substituting country-specific linear industry trends to non-linear common industry trends). Reassuringly, no major difference emerges. Columns 5 to 8 progressively include additional controls – namely: labour productivity, subsequently decomposed in TFP and the capital-labour ratio – on both the full sample and the sample restricted to high-wage countries, when possible.[18] The findings are, by and large, confirmed.

The nature of imports, however, is likely to differ across high-labour-share industries – that is those industries with an average labour share above the average for the whole manufacturing – and other industries. In fact, in capital intensive industries, imports are likely to come from other rich countries and simply be the result of international specialisation of labour induced by economies of scale. By contrast, imports from low-labour-cost countries are likely to be concentrated in labour intensive industries, typically characterised by large labour shares. In Panel B the model is re-estimated on high-wage countries only by allowing the coefficient of import penetration to differ between the two types of industries. Results broadly confirm that the negative impact of import penetration on industry activity is confined to high-labour-share industries.[19]

16. These correspond to Czech Republic, Estonia, Greece, Hungary, Korea, Poland and Portugal.

17. The sample includes Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Slovenia, Spain, Sweden, the United Kingdom and the United States.

18 . TFP and the capital-labour ratio are available only for a subset of high-wage countries. Therefore, when they are included, the sample is *de facto* restricted to high-wage countries only.

19 . Caution is required, however, about results in Panel B, since there are many other, possibly relevant interactions that are not included in the specification and differences across industry groups might turn out insignificant in a more refined model. This is issue is, nevertheless, beyond the scope of this paper (see Bassanini and Duval, 2009, for a discussion).

Table 5. **Competition from abroad-producing firms and industry shares**

Panel A: Homogeneous effect of import penetration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Import penetration	-0.143	-0.221***	-0.231*	-0.237**	-0.066	-0.085*	-0.132**	-0.166***
	(-1.487)	(-2.814)	(-1.861)	(-2.107)	(-1.006)	(-1.777)	(-2.213)	(-2.969)
Relative prices	0.357***	0.318***	0.566***	0.557***	0.928***	0.976***	0.939***	0.937***
	(6.635)	(5.263)	(7.241)	(7.104)	(21.558)	(20.735)	(18.252)	(18.151)
Labour productivity					0.813***	0.859***		
					(16.345)	(18.488)		
TFP							0.912***	0.912***
							(16.499)	(16.181)
Capital-labour ratio							-0.227***	
							(-5.634)	
ICT capital-labour ratio								-0.034*
								(-1.756)
Non-ICT Capital-labour ratio								-0.215***
								(-3.787)
Observations	784	664	784	664	784	664	560	560
R-squared	0.720	0.733	0.819	0.779	0.864	0.863	0.888	0.887
countryXtime dummies	yes	yes	yes	yes	yes	yes	yes	yes
industryXtime dummies	yes	yes	no	no	yes	yes	yes	yes
countryXindustry dummies	no	no	yes	yes	no	no	no	no
high-wage countries only	no	yes	no	yes	no	yes	n.r.	n.r.

Panel B: Heterogeneous effect of import penetration

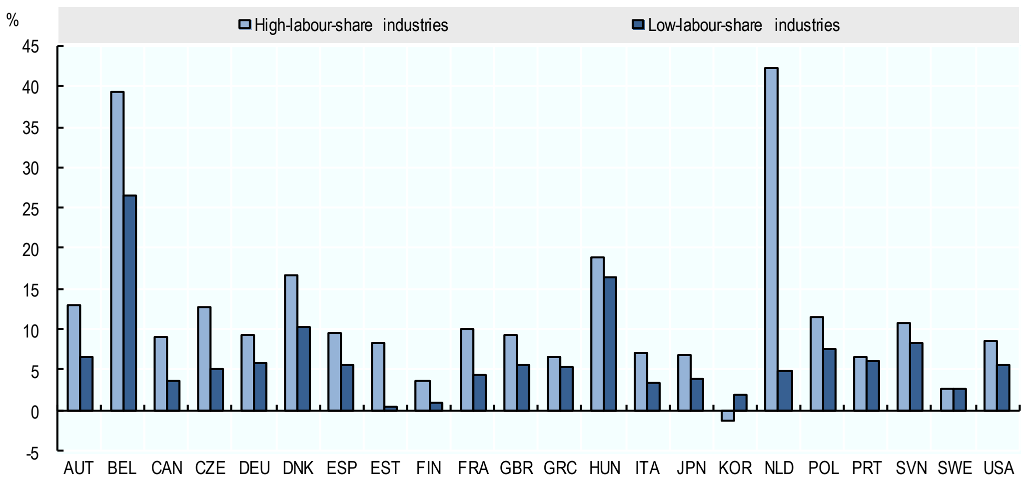
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Imp. pen. X low-labour-share ind.	0.023	0.034	0.019	0.011				
	(0.122)	(0.249)	(0.143)	(0.083)				
Imp. pen. X high-labour-share ind.	-0.248***	-0.098**	-0.148**	-0.185***	-0.251***	-0.102**	-0.150**	-0.186***
	(-3.314)	(-2.004)	(-2.319)	(-3.029)	(-3.577)	(-2.110)	(-2.476)	(-3.211)
Relative prices	0.328***	0.979***	0.940***	0.937***	0.328***	0.978***	0.940***	0.937***
	(5.336)	(20.691)	(18.107)	(18.018)	(5.398)	(20.703)	(18.135)	(18.041)
Labour productivity		0.857***				0.857***		
		(18.206)				(18.251)		
TFP			0.905***	0.904***			0.906***	0.904***
			(16.089)	(15.771)			(16.204)	(15.866)
Capital-labour ratio			-0.224***				-0.224***	
			(-5.557)				(-5.556)	
ICT capital-labour ratio				-0.034*				-0.034*
				(-1.730)				(-1.732)
Non-ICT Capital-labour ratio				-0.212***				-0.212***
				(-3.755)				(-3.750)
Observations	664	664	560	560	664	664	560	560
R-squared	0.734	0.864	0.889	0.888	0.734	0.864	0.889	0.888
countryXtime dummies	yes	yes	yes	yes	yes	yes	yes	yes
industryXtime dummies	yes	yes	yes	yes	yes	yes	yes	yes
countryXindustry dummies	no	no	no	no	no	no	no	no
high-wage countries only	yes	yes	n.r.	n.r.	yes	yes	n.r.	n.r.

Notes: Five-year differenced variables. Manufacturing only. The dependent variable is the 5-year difference in the log industry share in business sector value added. All covariates, except import penetration, are in logs. Import penetration: ratio of imports to apparent demand, lagged five years. Relative prices: ratio of the industry's value-added deflator to the consumption deflator. High-wage countries: countries with average gross hourly wage in purchasing power parity below 50% of the US wage rate in 1997. High-labour-share industries: industries with an average labour share above the average for the whole manufacturing. n.r.: not relevant (TFP data are available only for high-wage countries). Robust t-statistics in parentheses. ***, **, *: significant at the 1%, 5% and 10% level, respectively.

Does this imply that greater competition from abroad-producing firms, by triggering reallocation away from high-labour-share industries, depresses the aggregate labour share? The answer is a qualified yes. As shown in Figure 4, between 1990 and 2007, the growth of import penetration in manufacturing was, on average, almost twice as large in high-labour-share industries than in other industries.[20] In turn, given the estimates in Table 5, this implies a greater contraction of high-labour-share manufacturing industries, resulting in a decline of the aggregate labour share. More precisely, excluding low-wage countries, import penetration increased on average by about 6.5 percentage points more in high-labour-share industries than in low-labour-share industries. Using Column 2 of Panel A, this translates into 1.3% drop of the share of high-labour-share industries in business-sector value added. Taking into account that the labour share is, on average, 15 percentage points larger in high-labour-share industries, and that the latter account, on average, for 45% of manufacturing, these estimates suggest that, by inducing reallocation away from high-labour-share manufacturing, import competition from foreign firms induced a decrease of the labour share in the whole manufacturing by 0.1 percentage points, on average, between 1990 and 2007.[21] A similar conclusion is reached using estimates in Panel B.

Figure 4. **Average growth of import penetration by type of industry**

1990[a]-2007[b], percentage points



Notes: Manufacturing only. In each country, high-labour-share industries are those with an average labour share over the period above the average for the whole manufacturing.
a) Germany and Hungary: 1992; Finland and Sweden: 1993; Czech Republic, Korea and Poland: 1994; Estonia, Greece and Slovenia: 1995.
b) Canada: 2004; Korea and Portugal: 2005; Japan, Poland and Slovenia: 2006.

Source: Own calculations from OECD STAN family databases and EUKLEMS.

20 . On average, it was 12 and 6.5 percentage points in high and low-wage-share industries, respectively, for the countries reported in Figure 4. The above rates fall to 9 and 5.5 percentage points, respectively, if Belgium and the Netherlands, the clear outliers in Figure 4, are excluded.

21. As manufacturing is partitioned in two groups of industries in this calculation (high-wage-share and low-wage-share), the absolute value of the contribution to the between term of the shift-share decomposition can be computed as the change in the value added share of one of them (in percentage points) multiplied by the difference in the average labour share between the two groups of industries.

In addition, these results suggest that the insignificant coefficients reported in Table 4 should be viewed as an overestimate, in algebraic terms, of the true impact of competition from abroad-producing firms. In fact, competition from firms producing in countries with low labour cost is likely to be particularly strong for firms whose production activity is intensive in low-skilled labour. The measured downsizing of industries that are more exposed to rising import penetration is therefore likely to have been driven by exit or downsizing of these firms. In turn, this implies that these industries have probably become relatively more skill-intensive. Conditional to capital intensity, this has likely counterbalanced any downward push on the labour share in these industries, insofar as available evidence suggests that skilled labour's bargaining power is larger (*e.g.* Cahuc *et al.*, 2006). By contrast, unskilled workers are likely to have migrated to other industries – less affected by import competition – thereby driving down the labour share of those industries. As a consequence, given that the effects in Table 4 are identified through cross-industry comparisons of within-industry differences, they are probably upward-biased.[22]

Globalisation can exert influences also through other channels, however. For example, domestic companies can outsource abroad, or threaten to do so, part of the production chain – particularly the production of unskilled-labour-intensive intermediate inputs – as a strategy to cope with labour-cost pressures. Indeed OECD (2007) and Hijzen and Swaim (2007) find that intra-industry offshoring (defined as the ratio of imported inputs from the same industry to domestic industry output) is negatively associated with labour demand and positively associated with its wage elasticity.

Table 6 shows estimates of the within-industry impact of intra-industry offshoring on the labour share in manufacturing industries. Data on intra-industry offshoring are obtained from OECD input-output tables and are available only for three years (1995, 2000 and 2005). As a consequence [2] is estimated in long-differences and, as in the case of [3], offshoring is lagged once, in order to avoid the most obvious endogeneity biases.[23]

22 . Unfortunately, reliable data by skills or educational attainment are not available at a sufficiently disaggregated level to test further this hypothesis.

23. Unfortunately, given that data are available only for three years (1995, 2000, 2005) and that one lagged difference is considered for offshoring, country-by-industry dummies cannot be included, which makes it impossible to check that results are not due to opposite industry-specific trends in offshoring and the wage share. This is a limitation that must be kept in mind when looking at these findings.

Table 6. **Intra-industry offshoring and the labour share**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Offshoring	-0.182	-0.210*	-0.164	-0.245**	0.033	-0.302*	-0.327*
	(-1.639)	(-1.797)	(-1.511)	(-2.033)	(0.158)	(-1.642)	(-1.820)
Labour productivity			-0.160***	-0.224***	-0.106***		
			(-6.694)	(-7.250)	(-3.214)		
TFP						-0.283***	-0.368***
						(-4.395)	(-4.992)
Capital intensity						-0.030	
						(-0.355)	
ICT capital intensity							-0.003
							(-0.142)
Non-ICT capital intensity							-0.121
							(-1.546)
Observations	435	303	390	271	119	201	201
R-squared	0.275	0.261	0.422	0.470	0.495	0.510	0.520
CountryXtime dummies	yes	yes	yes	yes	yes	yes	yes
IndustryXtime dummies	yes	yes	yes	yes	yes	yes	yes
high-wage countries only	no	yes	no	yes	no	n.r.	n.r.
low-wage countries only	no	no	no	no	yes	n.r.	n.r.

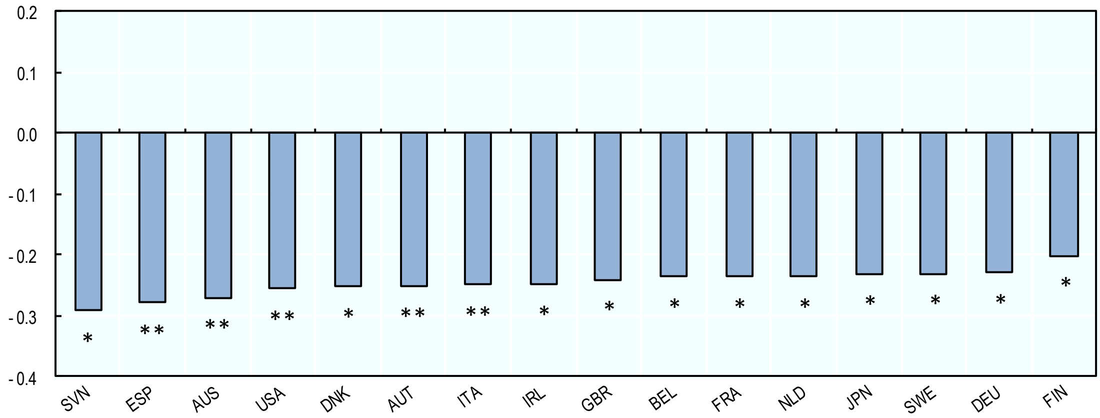
Notes: Five-year differenced variables. Manufacturing only. The dependent variable is the 5-year difference of the industry labour share, expressed as ratio of labour compensation to value added. All covariates, except offshoring, are in logs. Offshoring: ratio of imported same-industry inputs to domestic output, lagged five years. High-wage countries: countries with average gross hourly wage in purchasing power parity below 50% of the US wage rate in 1997. n.r.: not relevant (TFP data are available only for high-wage countries). Robust t-statistics in parentheses. ***, **, *: significant at the 1%, 5% and 10% level, respectively.

As in the case of the effect of imports on the industry share in value added, the effect of outsourcing abroad appears negative but insignificant in the full sample of countries, both without and with a control for log hourly productivity (Columns 1 and 3 of Table 6). However it seems natural to expect again that coefficients are heterogeneous between high-wage and low-wage countries. Indeed, when the sample is restricted to high-wage countries, estimated effects appear significant (Columns 2 and 4). Moreover, they do not seem to depend on the inclusion of any particular country in the sample. Re-estimating the preferred specification (Column 4) by excluding countries one-by-one does not appear to affect results significantly (Figure 5). By contrast, as expected, in low-wage countries offshoring has no detrimental effect on the labour share, suggesting again that workers in these countries do not suffer, and probably gain, from the division of labour across countries. These results appear largely confirmed when TFP and capital intensity are substituted for hourly productivity in the specification.[24]

24. By contrast, no significant impact of intra-industry offshoring on the share of the industry in total value added is found if a model similar to [3] is estimated.

Figure 5. **Sensitivity of the effect of offshoring on the labour share to countries included in the sample**

Point-estimates of the effect of offshoring once the indicated countries are excluded from the sample



Note: Coefficients obtained by re-estimating the specification of Column 2 of Table 6, excluding the indicated country. *, ** significant at the 10% and 5% level, respectively. Only high-wage countries are included.

Taken at face value, estimates in Column 4 of Table 6 imply that a one-percentage-point increase in intra-industry offshoring would reduce the labour share in the industry by a quarter of a percentage point. This effect is significant also from an economic point of view. Between 1995 and 2005 intra-industry offshoring has increased by 0.8 percentage points on average in the high-wage countries for which data are available. This variation should have induced a within-industry decline in the labour share by about 0.2 percentage points. As the average contraction of the labour share in these industries, countries and years was about 3 percentage points, this implies that the rise in intra-industry offshoring can account for about 7% of the within-industry reduction in the labour share in manufacturing, a small but significant effect. Again, however, as companies are more likely to offshore unskilled segments of the production chain, these estimates should be considered a lower bound to the true effect.

If the threat of delocalisation of production activities can exert a downward pressure on wages and labour demand, the evidence as regards inward foreign direct investment (FDI hereafter) is more mixed. Foreign takeovers are usually estimated to have positive effects on wage growth in the acquired firm (OECD, 2008, Hijzen *et al.*, 2010). There is evidence of wage spillovers to other domestic firms (Driffield and Girma, 2003). However, in rich countries the impact on employment in the acquired firm seems negative (see OECD, 2008, Hijzen *et al.*, 2010). In addition, there is evidence that job destruction is greater in subsidiaries that are geographically far from the headquarter (Landier *et al.*, 2009).[25] This suggests that

25. This evidence concerns mostly firms with headquarters and subsidiaries in the United States: we are indeed aware of only one study providing evidence that multi-national enterprises downsize more abroad than in their home country (Barban, 2010). Nevertheless, anecdotal evidence on this looms large in the press (see for example, *Business Week*, February 2, 2012, on the downsizing of a Japanese brokerage company, *Le Figaro* and *Le Temps*, January 17, 2012, on that of a Swiss pharmaceutical company, *Bloomberg*, February 2, 2012, on that of a British pharmaceutical company, and *Business Week*, January 26, 2012, on that of leading French banks). Typically, multinational enterprises are under political pressure in their home country to avoid domestic downsizing. See for example, *Wall Street Journal*, March 19, 2009, on French government pressures on one of the main French automobile companies to avoid shutting down a French

in the long-run, the threat of re-localisation abroad could partially compensate the short-run positive wage effect, particularly in rich countries.

One of the main difficulties in estimating these relationships is that takeovers and/or the volume of FDI are typically endogenous variables. In order to circumvent this problem, in this paper the impact of FDI on the labour share is estimated using OECD indicators on regulatory barriers to inward FDI. These indicators concern foreign equity limits, screening and approval, restrictions on top foreign personnel, and other restrictions concerning notably reciprocity rules and profit/capital repatriation. As a first approximation, these indicators can be considered exogenous, or at least less subject to reverse causality. As these barriers are often industry-specific, their within-industry association with the labour share can be studied using [2]. These indicators are available at approximately five-year intervals since 1997. For this reason, their impact is estimated using long-differences as in the case of offshoring. Conversely, as reverse causality is ruled out, FDI regulation is not lagged. The advantage of not lagging this variable is that it is possible, as a preferred specification, to include country-specific industry trends. This is important since otherwise estimates might simply capture correlations across trends, because FDI have been liberalised, and the labour share has declined, almost everywhere.

Table 7 presents estimates of the association between within-industry changes in the labour share and FDI regulation, including all components except those concerning directors and top managers and controlling for country-specific industry trends and all aggregate factors. Column 1 shows a negative but insignificant estimated relationship. Column 3 confirms this finding when productivity is included in the specification. This relationship does not seem to differ between high and low-wage countries. Indeed coefficients in Columns 2 and 4, obtained on the sample of high-wage countries, do not differ from those estimated on the full sample (Columns 1 to 3). By contrast, estimates appear to be particularly sensitive to the presence of France in the sample. Excluding France from the sample, a reduction in FDI regulation of 0.02 points – about the average variation of the OECD indicators that is observed between 1997 and 2006 – is, ceteris paribus, significantly associated to a within-industry increase in the labour share of 0.9 percentage points, a large effect (Column 5). This effect appears also reasonably robust to further elimination of countries one-by-one (Figure 6).[26] However, it becomes again insignificant if industry-by-time dummies are substituted for country-by-industry dummies in the specification, which should induce to extreme caution in looking at these results (Column 6).

plant. As, at that time, a French Minister put it: “the big question for the European auto industry is where to close factories: we just don't want them to close in France!”.

26. The effect becomes insignificant if Austria is excluded but becomes significant again if Belgium is further excluded.

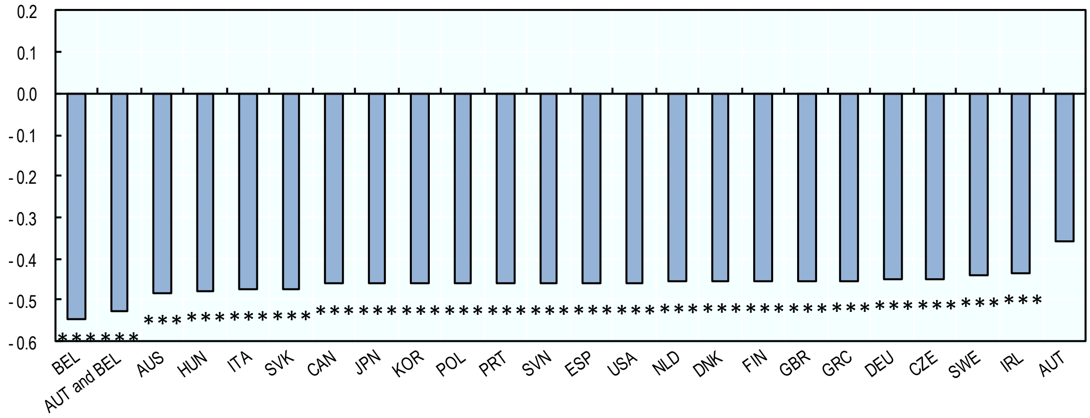
Table 7. **Inward-FDI regulation and the labour share**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FDI regulation (all, except on top managers)	-0.178	-0.121	-0.191	-0.162	-0.461***	-0.104	-0.460***
	(-1.162)	(-1.010)	(-0.806)	(-0.645)	(-3.026)	(-1.396)	(-3.008)
Labour productivity			-0.218***	-0.217***	-0.228***	-0.153***	-0.229***
			(-4.439)	(-3.172)	(-4.476)	(-4.997)	(-4.466)
FDI regulation (top managers)							0.815***
							(2.694)
Observations	789	589	705	527	671	671	671
R-squared	0.545	0.496	0.591	0.542	0.597	0.343	0.597
countryXtime dummies	yes	yes	yes	yes	yes	yes	yes
industryXtime dummies	no	no	no	no	no	yes	no
countryXindustry FE	yes	yes	yes	yes	yes	no	yes
high-wage countries only	no	yes	yes	yes	no	no	no
France excluded	no	no	no	no	yes	yes	yes

Notes: Five-year differenced variables. The dependent variable is the 5-year difference of the industry labour share, expressed as ratio of labour compensation to value added. Labour productivity is in logs. FDI regulation: OECD indexes of inward FDI regulation, varying from 0 to 1 from the lowest to the greatest degree of restriction. High-wage countries: countries with average gross hourly wage in purchasing power parity below 50% of the US wage rate in 1997. Robust t-statistics in parentheses. ***: significant at the 1% level.

Figure 6. **Sensitivity of the effect of FDI regulation on the labour share to countries included in the sample**

Point-estimates of the effect of FDI regulation once France and the indicated countries are excluded from the sample



Note: Coefficients obtained by re-estimating the specification of Column 5 of Table 7, excluding the indicated countries. *** significant at the 1% level.

Interestingly, the indicator of regulations concerning foreign directors and top managers, if included in the specification as a separate regressor, appears positively correlated with the labour share. Here again caution is required because regulation on personnel changed only in three countries during the sample window (Finland, Korea and the United Kingdom) and, as only two years of data are available for Korea, country-by-industry dummies swipe away the variation in this country, so that the effect is identified on two countries only.[27] Clearly, more research is needed on this issue. Nevertheless, if confirmed, two mechanisms could explain such finding. First, one of the positive spillovers from FDI comes from the acquisition of greater human capital by the workers. Acquired competences then diffuse into the rest of the economy when workers quit for jobs in domestic firms (see OECD, 2008, and references therein). It would not be totally surprising that this mechanism were especially relevant at manager level and, therefore, this effect were stronger if multinational enterprises were required to hire domestic managers. Second, and perhaps more important, there is a small literature showing that managers and directors tend to be less accommodating with labour requests when they do not come from the same local area (Yonker, 2010). In turn, this would suggest that foreign-managed subsidiaries of foreign multinationals might downsize more frequently and/or be less sensitive to upward wage claims from workers.

Overall, globalisation, in its multiple facets, appears to play a role in driving the contraction of the labour share. There is some evidence that within-industry increases in offshoring tend to reduce the labour share, while competition from abroad-producing firms in domestic markets tend to induce structural changes that have an adverse effect on the aggregate labour share. The sum of these two effects accounts for about 10% of the observed decline. Moreover, as discussed, this figure is likely to be an underestimate of the true negative effect. By contrast, the findings of Table 7 suggest that deregulation of inward FDI, at least excluding rules on top personnel, is unlikely to have contributed to the contraction of the labour share. If any, its decline is likely to have been slowed down by these deregulatory actions.

The influence of rising product market competition and privatisation in network industries

One of the largest policy changes that occurred in OECD countries in the past two/three decades was the significant liberalisation of product markets. Barriers to competition have been lifted in many industries and many state-owned enterprises (SOEs hereafter) have been privatised (see *e.g.* Wölfl *et al.*, 2009). Economic theory suggests that deregulation of barriers to entry should decrease the rents accruing to the firm, and thus those accruing to the workers. However, to the extent that workers' bargaining power is not such that they appropriate the firm's full rent, price mark-ups are greater than wage mark-ups – that is the wedge between the bargained wage and the reservation wage. If workers' bargaining power remains constant, the wage bill in nominal terms should decrease less than nominal value added and, therefore, the wage share should increase (see for example Blanchard and Giavazzi, 2003). Yet, the assumption that bargaining power remains constant is very restrictive. The evidence suggests that the gap between productivity and wages is larger in those firms that are created in the aftermath of an increase in competition (*e.g.* Hirsch, 1988, Böckerman and Maliranta, 2012). This suggests that workers' bargaining power in incumbent firms is larger than in entrants and reallocation from the former to the latter leads to a reduction of bargaining power making more ambiguous theoretical predictions as regards the impact of barriers to entry on the labour share.

By contrast, Azmat *et al.* (2012) suggest that the wage share should be larger in SOEs. They build a theoretical model of "empire building" in which entrenched managers of SOEs with low profit stakes (and weak budget constraints) care about size as much as they care about profits. This occurs because, for them, greater size is a vehicle for greater power. As a result, the labour demand curve shifts outward: for any given level of the wage, employment is larger. At the firm level this implies a larger wage share and, in equilibrium, lower wages and greater employment than the combination that would maximise profits. Similar results would occur if SOEs' managers were influenced by politicians, who, in turn, care about

27. However, if country-by-time dummies are replaced by industry-by-time dummies, this effect remains significant and robust to elimination of countries one-by-one from the sample.

employment for political reasons (*e.g.* Bertrand *et al.*, 2005). In both cases one can expect that privatisation reduces labour shares.

Product market deregulation and privatisation have been particularly extensive in network industries (gas, electricity and water supply, transports, and communications). These industries, therefore, provide an interesting laboratory to study the effect of deregulation on the labour share. In addition, reliable industry-specific indicators of anti-competitive product market regulation are essentially available only for these industries. For these reasons, the relationship between barriers to entry, privatisation and the labour share is examined empirically by restricting the sample to network industries, relying on OECD indicators of barriers to entry and public ownership in these industries. As the number of industries is small and there are important trends in deregulation, [2] is estimated by including three sets of double dimensional dummies.[28] The sample includes 25 countries between 1980 and 2007.[29] The large number of covariates (due to the multiple sets of dummies) prevents the use of GMM estimators. However, as a first approximation and following a large number of studies (*e.g.* Alesina *et al.*, 2005, Guadalupe, 2007, Aghion *et al.*, 2009) regulation is treated as exogenous. Thus, the use of static fixed-effect models (FE) appears an acceptable choice, provided that the results are robust to inclusion/exclusion of productivity terms in the specification.

Table 8 presents baseline results. Column 1 is based on the largest possible sample and, therefore, a specification without controls, except for double-dimensional dummies. In Column 2, hourly productivity is included. In both specifications, public ownership appears to be positively associated to the labour share, while regulations concerning entry barriers are by and large orthogonal to it. This suggests that declines in average bargaining power brought about by sustained firm entry have accompanied the reduction in price mark-ups.

28. That is country-by-industry fixed effects, country-by-time dummies, to control for aggregate co-variates, and industry-by-time covariates, to control for industry-specific trends.

29. The empirical analysis of this section is much inspired by that of Azmat *et al.* (2012), who find a significant positive effect of public ownership on the labour share and a negative impact of barriers to entry. The analysis here improves on what they did on three grounds: *i)* aggregate effects are controlled for; *ii)* almost ten years of additional data are considered, including the 2000s where deregulation continued at a sustained pace in many countries; and *iii)* a larger number of countries is considered.

Table 8. **Public ownership, barriers to entry and the labour share**

	(1)	(2)	(3)	(4)	(5)	(6)
Public ownership	0.015***	0.013***	0.016***	0.013***	0.025***	0.012**
	(3.631)	(3.026)	(3.692)	(2.892)	(4.102)	(2.129)
Barriers to entry	0.003	-0.001				
	(1.106)	(-0.280)				
Labour productivity		-0.105***		-0.104***		
		(-5.211)		(-5.191)		
TFP					-0.153***	-0.238***
					(-3.737)	(-7.023)
Capital intensity					-0.106***	
					(-3.233)	
ICT capital intensity						0.016*
						(1.946)
Non-ICT capital intensity						-0.201***
						(-7.290)
Observations	1,603	1,603	1,628	1,628	1,002	1,002
R-squared	0.941	0.944	0.942	0.944	0.958	0.962
countryXtime dummies	yes	yes	yes	yes	yes	yes
countryXindustry FE	yes	yes	yes	yes	yes	yes
industryXtime dummies	yes	yes	yes	yes	yes	yes

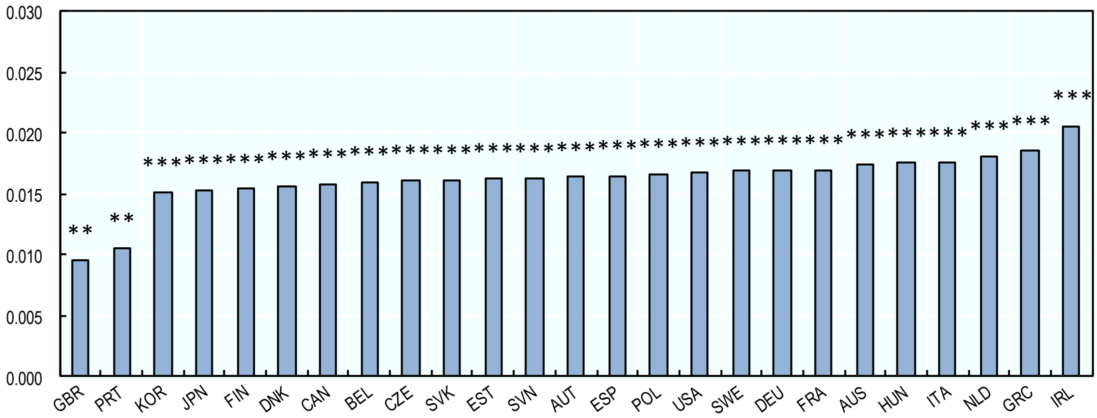
Notes: Network industries (electricity, gas and water supply; transports; and communications) only. The dependent variable is the industry labour share, expressed as ratio of labour compensation to value added. All covariates, except public ownership and barriers to entry, are in logs. Public ownership: OECD index of public ownership, varying from 0 to 6 from the lowest to the greatest extent of ownership. Barriers to entry: OECD index of entry regulations, varying from 0 to 6 from the lowest to the greatest restrictions. Robust t-statistics in parentheses. ***, **, *: significant at the 1%, 5% and 10% level, respectively.

Excluding barriers to entry from the specification does not significantly affect estimated coefficients (Columns 3 and 4), which appear also robust to exclusion of countries one-by-one from the sample (Figure 7). Substituting capital intensity and TFP for hourly productivity yields consistent estimates (Columns 5 and 6).[30]Estimated results appear also robust to different specifications of country, industry and time effects. The first six columns of Table 9 present estimates obtained by excluding industry-by-time dummies from the specifications. Columns 7-9 of the same table replicate the results by excluding country-by-time dummies. In both cases the key parameter of interest appears extremely robust.

30. Interestingly, point estimates for TFP and capital intensity variables are close to those reported in Table 1 despite the differences in the sample and estimation method.

Figure 7. **Sensitivity of the effect of public ownership on the labour share to countries included in the sample**

Point-estimates of the effect of public ownership once the indicated countries are excluded from the sample



Note: Coefficients obtained by re-estimating the specification of Column 3 of Table 8, excluding the indicated country. **, *** significant at 5% and 1% respectively

Table 9. **Public ownership and the labour share: varying the specification of country, industry and time effects**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Public ownership	0.017***	0.009**	0.018***	0.009**	0.020***	0.014***	0.014***	0.010***	0.012***
	(4.652)	(2.397)	(4.859)	(2.204)	(3.893)	(2.795)	(4.674)	(3.329)	(3.332)
Barriers to entry	0.003	-0.002							
	(0.988)	(-0.834)							
Labour productivity		-0.077***		-0.075***				-0.052***	
		(-5.737)		(-5.758)				(-3.062)	
TFP					-0.108***	-0.226***			-0.103***
					(-3.034)	(-6.600)			(-2.722)
Capital intensity					-0.062**				-0.085***
					(-2.381)				(-2.735)
ICT capital intensity						0.023***			
						(2.939)			
Non-ICT capital intensity						-0.181***			
						(-6.351)			
Observations	1,603	1,603	1,628	1,628	1,002	1,002	1,628	1,628	1,002
R-squared	0.937	0.940	0.938	0.941	0.954	0.959	0.891	0.892	0.923
countryXtime dummies	yes	yes	yes	yes	yes	yes	no	no	no
countryXindustry FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
industryXtime dummies	no	no	no	no	no	no	yes	yes	yes

Notes: Network industries (electricity, gas and water supply; transports; and communications) only. The dependent variable is the industry labour share, expressed as ratio of labour compensation to value added. All covariates, except public ownership and barriers to entry, are in logs. Public ownership: OECD index of public ownership, varying from 0 to 6 from the lowest to the greatest extent of ownership. Barriers to entry: OECD index of entry regulations, varying from 0 to 6 from the lowest to the greatest restrictions. Robust t-statistics in parentheses. ***, **: significant at the 1% and 5% level, respectively.

Taking estimates of Columns 3 and 4 of Table 8 at face value, these results would suggest that a pace of privatisation involving a reduction of the indicator by 0.1 points per year – about the average annual change that is observed in OECD countries between 1990 and 2007 – would induce a contraction of the labour share in these industries of about 0.13-0.25 percentage points per year, which represents between one third and 60% of the observed variation of the labour share. These estimates are, however, based on the assumption that the positive effect of public ownership on the labour share is constant over the whole estimation period (1980-2007). It might be argued that this assumption is restrictive. In particular, while it is likely that the governance of SOEs in the 1980s was such that different objectives from profit-maximisation were pursued by their management, this is probably not the case for all firms that were still state controlled in the 2000s, when SOEs were often asked to behave as private-for-profit firms. In Table 10 this possible parameter instability is explored. It appears that the best fit is obtained by allowing the effect of public ownership to differ in the 1980s and the rest of sample. The estimates confirm the expectation that the positive impact of public ownership on the labour share was much larger in the 1980s.[31] Taking estimates of Columns 1 and 2 at face value, these results suggest that privatisations between 1990 and 2007 dampened the labour share in network industries by about 0.09-0.19 percentage points per year, which represents between 22% and 40% of the observed decline.

Table 10. **Public ownership and the labour share: allowing different effects over time**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Public ownership	0.012***	0.009**	0.022***	0.019***	0.011***	0.009**	0.019***	0.019***
	(2.874)	(2.136)	(3.743)	(4.033)	(2.730)	(2.180)	(3.429)	(4.192)
Public ownership (add. eff. before 1990)	0.016***	0.015***	0.015***	0.010**	0.016***	0.015***	0.013***	0.010**
	(3.848)	(3.516)	(3.300)	(2.578)	(3.704)	(3.574)	(3.049)	(2.513)
Barriers to entry					0.000	-0.003	0.011***	0.005
					(0.118)	(-1.010)	(2.959)	(1.554)
Barriers to entry (add. eff. before 1990)					0.006	0.005	-0.007	-0.007
					(0.999)	(0.738)	(-1.011)	(-1.240)
Labour productivity		-0.102***		-0.108***		-0.103***		-0.107***
		(-5.091)		(-6.015)		(-5.147)		(-5.854)
TFP			-0.163***				-0.156***	
			(-3.980)				(-3.771)	
Capital Intensity			-0.110***				-0.112***	
			(-3.323)				(-3.401)	
Observations	1,628	1,628	1,002	1,308	1,603	1,603	1,002	1,308
R-squared	0.942	0.945	0.959	0.956	0.942	0.944	0.959	0.956
countryXtime dummies	yes	yes	yes	yes	yes	yes	yes	yes
countryXindustry FE	yes	yes	yes	yes	yes	yes	yes	yes
industryXtime dummies	yes	yes	yes	yes	yes	yes	yes	yes
Only countries with obs. before and after 1990	no	no	no	yes	no	no	no	yes

Notes: Network industries (electricity, gas and water supply; transports; and communications) only. The dependent variable is the industry labour share, expressed as ratio of labour compensation to value added. All covariates, except public ownership and barriers to entry, are in logs. Public ownership: OECD index of public ownership, varying from 0 to 6 from the lowest to the greatest extent of ownership. Barriers to entry: OECD index of entry regulations, varying from 0 to 6 from the lowest to the greatest restrictions. Robust t-statistics in parentheses. ***, **: significant at the 1% and 5% level, respectively.

Are these figures large or small from the point of view of the whole business sector? Network industries accounted on average for 15% of business sector's value added in this period. Therefore, the measured process of privatisation in network industries accounted for 3.5%-6.7% of the average within-industry contraction of the labour share, which is already at least one half of the overall effect of globalisation that was estimated in the previous subsection. However, in many countries, sales of government shares in SOEs did not occurred only in network industries. For example, the privatisation of IRI and its subsidiaries in Italy in the 1990s involved reduction of public ownership in several industries including financial intermediation, construction, real estate and food manufacturing. Although one needs to

31. Interestingly, there is also some – albeit less robust – evidence that the association between barriers to entry and the labour share was more positive in the 1990s (see Columns 7-8 of Table 10), which might suggest that liberalisation reforms in the past two decades have had an increasingly weakening impact on workers' bargaining power.

be cautious about extending the findings for network industries to other industries, the true impact of privatisation on the business sector's labour share is likely to have been much larger than the measured effect and, probably, at least as important as that of globalisation.

Concluding remarks

The steady decline of the labour share is a remarkable stylised fact of the past decades. This paper shows that the pressure arising from delocalisation and increasing competition from firms producing in countries with low labour costs can account for at least 10% of the overall decline of the labour share. Privatisation of state-owned enterprises also led to a decline of the labour share. Yet, TFP growth and capital deepening appear to be, by far, the most important forces behind the decline of the labour share.

What explains this strong negative effect of technical change and capital accumulation on the labour share? One possible explanation has to do with the diffusion of information and communication technologies (ICT) as a general-purpose technology. In the past thirty years, the spread of a new technological paradigm based on ICT would have created opportunities for unprecedented advances in innovation and invention of new (increasingly cheaper) capital goods and production processes, thereby boosting productivity but also allowing extensive automation of production and high substitution between capital and labour (see e.g. Greenwood and Jovanovic, 1999). Other scholars have advanced the possibility that technical change, within this context, could in fact be labour-replacing, in the sense that technological progress takes the form of machines replacing tasks previously performed by labour. In turn, this would especially reduce job opportunities for low-educated workers and, in practice, dampen the aggregate productivity of low-skilled labour (see Zeira, 1998, and the survey on machine-replacing-labour technical change in Acemoglu, 2011).

Both interpretations appear consistent with two additional results presented in this paper. First, labour productivity growth appears to have been associated with increases in the share of those with tertiary education in labour compensation and contractions of the shares of those with lower levels of education, and particularly those with less than upper-secondary education. Second, decomposing further this association, ICT capital accumulation appears to have had an especially negative effect on the lowest educated, while TFP growth impacts particularly on the share of those with intermediate education. These two results taken together suggest that, in the period under analysis, technical change embodied in ICT capital was strongly biased against the low-educated, while disembodied technical change was strongly biased towards high-skilled labour. While the first result is fully consistent with the literature on skill-biased technical change, one possible explanation for the latter is that disembodied technical improvements reflects embodiment in intangible capital (entrepreneurship, output from R&D departments, ideas of high-ranking managers, high-performing human resource practices) – that is improvements that are essentially incorporated in highly-qualified personnel.

From a policy perspective, one key question that cannot be answered with the data at hand is whether the negative relationship between technical progress and changes in the labour share is a long-lasting relationship or is specific to the past thirty years and will progressively disappear with the slow-down in the process of diffusion of ICT-based technologies. On the one hand, the standard view in the theory of economic growth is that, in the long run, capital and labour are complements and technical change augments the factor that cannot be accumulated (*i.e.* labour, see e.g. Acemoglu, 2002). Hence, capital-augmenting technical change and substitutability between capital and labour are likely to be only a temporary phenomenon due to the rapid diffusion of ICT-based technologies and related innovations. By contrast, according to this view, to the extent that skilled-labour supply increases faster than unskilled-labour supply, thereby increasing incentives to create capital goods complementary to skilled labour, technical change would remain biased against the unskilled. On the other hand, a more pessimistic view considers that ICT has changed the nature of technological advances, making them more rapid but incorporated in machines whose main purpose is to replace jobs previously held by certain categories of workers (Brynjolfsson and McAfee, 2011, Acemoglu, 2011). If this were the case, most workers, and in particular the least educated, would find themselves in a "race against the machine", thereby increasingly worsening their relative position. Whatever the view, this discussion suggests that countries should consider policies to increase their investment in education, in order to limit the adverse consequences of this tendency on income inequality. These interventions should be particularly targeted at reducing the number of school dropouts and better matching the skills acquired through education with those that are in demand in the market.[32]

Appendix: Data construction, sources and descriptive statistics

Earnings and hourly wage data refer to total gross annual earnings and average hourly wages, respectively of wage and salary employees. Employment and hours worked refer to annual averages for wage and salary employees. Real value added is obtained by deflating nominal value added in each industry with the industry-specific double deflator. Capital services and TFP data are also from the EUKLEMS Database and are constructed using double-deflated value added. EUKLEMS data obtained through interpolation and/or estimated on the basis of conjectures were removed from the sample, following the criteria detailed in OECD (2011b). For the computation of the labour share in each industry, average hourly compensation of self-employed is assumed to be equal to the average hourly wage of the industry. 1997 USD purchasing power parities data, drawn from EUKLEMS, are used for the definition of high-wage countries.

The distributions by educational attainment of earnings, wage, and hours also come from the EUKLEMS Database. Education is divided into three categories: low-education (less than upper secondary); medium education (upper secondary); and high education (more than upper secondary). The business sector, in this case, is partitioned in 9 industries for reasons of data reliability (following the criteria detailed in OECD (2011b).

The indexes of anti-competitive product market regulation, including public ownership and barriers to entry, come from the OECD Regulatory Database. They vary from 0 to 6 from the least to the most restrictive. Time-varying aggregate data are available for three industries (Energy, Transport and Communications) from 1975 to 2008.

Import-weighted real exchange rates are defined as follows:

$$x_{ikt} = \sum_{i=1}^{I}\sum_{l=1}^{L} m_{iklt_0} e_{klt} p_{lt} / p_{kt}$$

where x stands for the import-weighted real exchange rate, m is to the import share from country l in industry i of country k at a fixed time period t_0 (early 1980s in these data) – the import weights thus vary across industries and countries but are constant over time – e is the nominal bilateral exchange rate

32 . As the managing director of a US leading manufacturer of prototypes put it, "people don't seem to come in with the right skill sets to work in modern manufacturing. It seems as if technology has evolved faster than people. [… The advantage of capital equipment is that] you don't have to train machines" (*New York Times*, June 10th, 2011).

between countries k and l at time t – which varies across partner countries and time, but not across industries – the p variables refer to price levels, as approximated by the GDP deflator, in countries l and k respectively. An increase in the industry-specific exchange rate represents a real depreciation in the price of output produced in industry i of country k relative to its trading partners (weighted by import shares). Put differently, an increase in the industry-specific exchange rate represents an improvement in the terms of trade in industry i for country k. The source is OECD (2007).

Import penetration is defined as the ratio imports to apparent demand (imports plus output minus exports). Trade exposure is the sum of import penetration and export propensity, the latter defined as the ratio of exports to domestic output. The source of both variables is the OECD STAN Database. For industry i in country k, intra-industry offshoring is defined as the ratio of imported intermediate purchases from the same industry to that industry's domestic output:

$$o_{ikt} = \frac{M_{ikt}}{Y_{ikt}}$$

Where M refers to the imports of intermediates from industry i by industry i, and Y refers to domestic output in industry i. This indicator is computed using OECD Input-Output tables, available for 1995, 2000 and 2005.

OECD industry-specific indicators on regulatory barriers to inward FDI concern foreign equity limits, screening and approval, restrictions on top foreign personnel, and other restrictions concerning notably reciprocity rules and profit/capital repatriation. For each of these components the indicator vary between 0 and 1 from the least to the most restrictive. They are available between 1997 and 2006 at approximately five year intervals. Missing data were interpolated. In the regressions, missing 2007 data are replaced with 2006 data. All components, except restrictions on top foreign personnel, were lumped together by simple addition. The source is Kalinova *et al.* (2010).

Table A1 reports descriptive statistics of main variables.

Table A1. **Descriptive statistics of the main variables**

Variable	Obs	Mean	Std. Dev.
Labour Share	10116	0.678	0.187
Labour Productivity (1997$ PPP per hour)	10116	29.332	34.168
log TFP (base: US 1995=log(100))	5944	4.433	0.567
Capital services to value added	5944	0.379	0.302
IT capital services to value added	5944	0.050	0.069
Non-IT capital services to value added	5944	0.338	0.282
Real industry-specific exchange rate	4958	33.757	104.605
Import penetration	4395	0.424	1.135
Trade exposure	4395	0.809	1.257
Intra-industry offshoring	1309	0.071	0.084
FDI regulation (all except top managers)	1237	0.056	0.128
FDI regulation (top managers)	1237	0.004	0.018
Public ownership	1628	3.428	1.627
Barriers to Entry	1603	3.622	1.856

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