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Bargaining, Openness, and the Labor Share

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This paper investigates determinants of changes of the labor share in developed countries with a focus on Western Europe. Using a country-industry panel that covers the private sector, the paper focuses on long and short-run changes within industries. The results show a large and time-persistent impact of increasing globalization on the labor share, especially if the within-industry changes are considered. Openness seems to be the driving force for downward movements in the industry level labor shares while technological and institutional forces impact these shares positively. Furthermore, while investments into information and communication technology (ICT) increase productivity of workers, it has a negative impact on the labor share as it enables higher economic integration which lowers the labor share. Economic integration has stronger impact on the polarization in Western European labor markets than ICT.

Keywords: Labor Share, Functional Income Distribution, Openness
JEL Classification: E25, J23, F16, O33, E02

1. Introduction

Since the 1980s Western European countries have been confronted with rising inequality, falling real wages for subgroups of workers and high unemployment while economies were growing at the same time. These developments lead to the question on how income is distributed among factors of production. The share of total income from production received by the workers, the labor share, captures the labor market outcome of workers. It is influenced by bargaining power, globalization, and technological progress. Especially, increasing economic integration and advances in information and communication technologies (ICT) have changed the production processes and possibilities for firms and thus affected the functional distribution of income. In order to address the issue of a growing capital share or growing inequality, it is crucial to understand the main influences determining the division of income.

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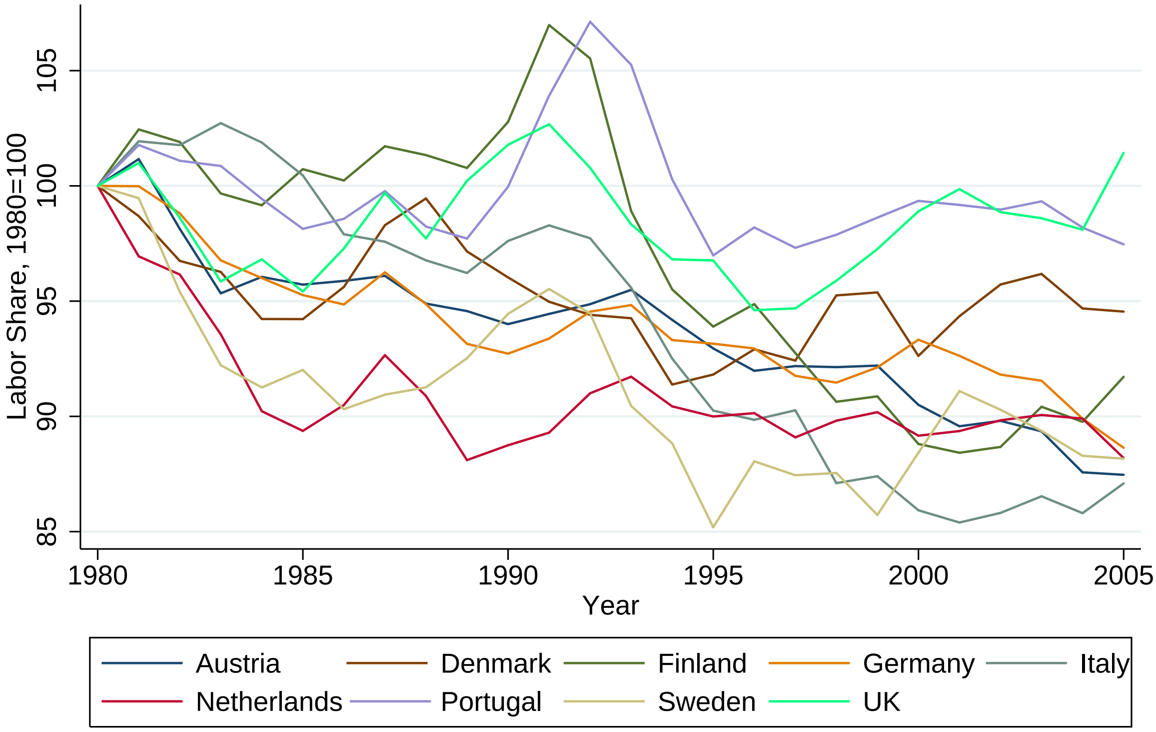

Figure 1: Labor Share Relative to its Value in 1980; source: EU KLEMS, Author's Calculations.

In this paper, I investigate these influences in a unifying framework. I estimate the short and long-run dynamics of labor market institutions, technology, and economic integration on the labor share in Western Europe on the industry level. Employing a large dataset from various sources for nine Western European countries on a two-digit industry level, I estimate the within-industry changes of the labor share which are due to various influences on the bargaining process in the labor market. Investigating the short and long-run dynamics is especially interesting as most Western European countries where faced with a negative trend in the labor share since 1980 while the labor share also moved with the business cycle. Figure 1 shows the evolution of the labor share by country for the large dataset from 1980 to 2005 where the value in 1980 is set to 100. The trends are different in their magnitude and timing. Simply judging by the graphs, the labor share seems to have larger swings in Finland, Denmark, Portugal, and the UK while in the other countries the labor shares seem to swing less but with a stronger trend. This analysis aims at finding common sources for the short- and medium-run movements of the shares within industries and countries.

I conclude that next to capital, which is a complement to labor in production, international trade and increasing economic integration have long-term impacts on the overall labor share. While these influences are similar across sectors and skill-groups, the influences of labor market institutions depend on the skill-level and sector. Furthermore, I investigate the connection between ICT-capital and economic integration. I find that ICT-capital itself is complementary to labor, especially in the service sector and for medium-skilled workers. The overall impact of ICT-capital on the labor share is nevertheless insignificant as it enables higher economic integration also through cheaper production and investments abroad.

After Blanchard (1997) highlighted the increasing capital share in European countries, a literature trying to understand the decreasing labor share evolved. The influential paper by Bentolia and Saint-Paul (2003) describes the direct relationship between the capital-output ratio and the labor share. They find a close relationship between both and are able to determine the impact of institutions on this relationship. They also estimate a model based on industry-level data and find support for a strong relationship between the technological influences and less influence of institutions on the labor share. Unfortunately, they do not include information on globalization or ICT. The same holds for Checchi and Garcia-Penalosa (2010), who find a higher importance of institutions on the labor share, but only estimate on the country level. Other studies, such as Harrison (2002), Guscina (2007), Jaumotte and Tytell (2008), the European Commission (2007), and Jayadev (2007) investigate the impact of different openness indicators on the labor share and find negative influences of increasing economic integration on the labor share. The European Commission (2007) also include the investigation of several skill groups and find heterogeneous results by skill for most variables. These papers are based on country level data and therefore cannot differentiate between variation coming from the sectoral composition within an economy or changes in the labor market outcomes within industries. If most variation in developed countries is coming from a growing share of value added of industries with lower labor share, such as of service industries, then it is desirable to estimate on industry-level rather then on country-level.

Using an error-correction approach, I can distinguish between long-term impacts and short-run dynamics. Furthermore, I am able to look into more detail on how manufacturing and service sector are affected differently. Having information about the labor share of high-, medium-, and low-skilled workers it is possible to analyze whether technology, institutions, or globalization is favoring specific skill-groups and whether these influences increase inequality not only between capital and labor but also within labor categories. As ICT and globalization influence each other, I also investigate the specific individual effects as well as a common impact of ICT and globalization on the labor share.

In the remainder of the paper I will first derive hypothesis on the determinants of the labor share from a theoretical bargaining model. This section also includes the econometric specification. In the third part of the paper I will explain the data and present some descriptive statistics. The empirical results and a discussion can be found in section four. Section five concludes.

2. Theoretical Considerations and the Estimation Procedure

2.1. Determination of the Labor Share in a Nash-Bargaining Framework

In order to analyze the labor share, the wage and employment setting mechanisms have to be analyzed. Under perfect competition in the labor and product markets the labor market will clear under profit maximization of firms if the firms choose employment such that the marginal product of labor equals the real wage. Thus, the demand for labor is defined by its marginal productivity. In a well cited paper Bentolia and Saint-Paul (2003) show that under the two assumptions of constant returns to scale and labor-augmenting technological progress the labor share is a direct function of the capital-output ratio as long as wages equal the marginal product of labor. The relationship between the labor share and the capital output ratio, which they call "SK schedule", depends on the production technology and, most importantly, on the elasticity of substitution between capital and labor. Complementarity of the two input factors lets the labor share rise if the capital-output ratio increases, while substitutability results in a decrease of the share. Under these assumption of perfect competition, the sole determinant of the labor share is the production technology.

Bentolia and Saint-Paul (2003) discuss factors which cause movements *on* the SK-schedule (e.g. input-price movements), movements *of* the SK-schedule (e.g. shifts in technology), and movements which lead to outcomes which are not on the schedule at all. For the outcome to lie *off* the SK-schedule, there needs to be a divergence of the wages away from the marginal product of labor. This can be the case if workers have bargaining power and manage to negotiate a wage which lies above the labor demand curve at a given level of employment.

Classically, the bargaining of workers and firms over their quasi-rents is represented by a Nash-Bargaining framework. Usually, the literature differentiates between two ways of bargaining.[1] In the right-to-manage model, the firms and workers bargain over wages and the firm then sets the level of employment independently such that it maximizes its profits. The wage-employment combination therefore lies on the labor demand curve of the firm. In the efficient bargaining model the workers and firms bargain over wages and employment simultaneously. The resulting possible wage-employment combinations define a contract curve which lies to the right of the labor demand curve in the wage-employment plane and is upwards sloping. Thus, for every wage the firms employ more workers than they would if the workers did not have any bargaining power.

Nash-Bargaining is a common starting point in the literature when the labor share is analyzed. Various versions of the bargaining processes described above can be found.[2] In the following, I derive the labor share from a simple efficient bargaining model with outside options of the firms and workers and a production technology employing capital and labor. I will also discuss the effects of changes in competition in the product markets and irreversible capital investments on the labor share.

In this model workers and firms bargain over wages and employment by maximizing their quasi-rents. The quasi-rent of the workers is defined by the difference between the wage bill, denoted by product of wages, w, and employment, L, and the income under the workers' outside option, $L\overline{w} \geq 0$. As workers are not fully mobile, the outside option is usually regarded as unemployment benefits rather than alternative wages outside the economy. The quasi-rent of the firm is then the total revenue of the firm, $PY = PF(K, L)$ minus the costs of the input factors labor and capital, wL and rK, and minus its outside option, $D \geq 0$. D could be the net profits of a possible relocation of the production process abroad. Workers and firms maximize the product of their quasi-rents, weighted by their respective bargaining power, α

[1] See McDonald and Solow (1981), Lever and van Veen (1991), and Cahuc and Zylberberg (2004) for an in depth discussion of both approaches.

[2] Bentolia and Saint-Paul (2003) explain both bargaining concepts, but do not introduce an outside option of the firm. Arpaia et al. (2009) derives the labor share under the assumption that low-skilled workers' wages and employment are bargained over while high-skilled are paid by their marginal product. Checchi and Garcia-Penalosa (2010) use a similar approach, where low-skilled workers bargain under a right-to-manage framework, while high-skilled workers are paid under an efficiency wage concept. Also the European Commission (2007) derive the labor share under the assumption of a right-to-manage framework. Jayadev (2007) introduces an outside option of the firm, while he leaves out capital in the production process.

and $(1-\alpha)$, with respect to wages and employment:

$$max_{w,L}\left(L\left(w-\overline{w}\right)\right)^{\alpha}\left(PF\left(K,L\right)-wL-rK-D\right)^{1-\alpha} \tag{1}$$

The first-order conditions are as follows

$$w:\ \alpha\left(PF\left(K,L\right)-wL-rK-D\right)=\left(1-\alpha\right)\left(w-\overline{w}\right)L \tag{2}$$

$$L:\ \alpha\left(PF\left(K,L\right)-wL-rK-D\right)=\left(1-\alpha\right)\left(w-F_L\right)L \tag{3}$$

where F_L is the first derivative of $F\left(K,L\right)$ with respect to L.

From the two first-order conditions one can find, that under efficient bargaining, the bargained wages and employment are set in such a way that the marginal product of labor equals the outside option of the workers, $\frac{\overline{w}}{P}=F_L$.[3]

After rearranging equation (2) the following condition can be found

$$wL=\alpha\left(PF\left(K,L\right)-rK-D\right)+\left(1-\alpha\right)\overline{w}L. \tag{4}$$

Dividing this by total revenue, the labor share is then[4]

$$s_L=\alpha\left(1-r\frac{K}{PY}-\frac{D}{PY}\right)+\left(1-\alpha\right)\frac{\overline{w}L}{PY}. \tag{5}$$

Here, the labor share equals the sum of the shares of the quasi-rents of the firms and the labor-output ratio times the outside option of the workers, weighted by the respective bargaining power. The labor-output ratio times the outside option would equal the labor share if the wage of the workers would be exactly equal to their outside option.

Similarly, one can rearrange equation (3). This leads to the following labor share

$$s_L=\alpha\left(1-r\frac{K}{PY}-\frac{D}{PY}\right)+\left(1-\alpha\right)\frac{F_L L}{Y}. \tag{6}$$

This is the weighted sum of the share of the quasi-rent of the firm and the production elasticity of labor. This elasticity is equal to the labor share if the wage equals the workers' marginal productivity. If the workers have no bargaining power the share of quasi-rents from the firm disappears and only the partial production elasticity remains.

Combining equations (5) and (6) with the condition that $\frac{\overline{w}}{P}=F_L$ the labor share is a function G of the following variables:

$$s_L=G\left(F\left(K,L\right),D,\overline{w},\alpha\right) \tag{7}$$

A rise in the bargaining power of the worker leads to a rise in the labor share, as it will secure a larger share of the rents if the quasi-rent of the firm is positive: $\frac{\partial s_L}{\partial\alpha}=1-\frac{rK}{PY}-\frac{D}{PY}-\frac{\overline{w}L}{PY}$. This is positive as long as total revenue exceeds the costs for capital, labor costs under the outside option of the worker, and the value of the outside option of the firm: $PY>rK+\overline{w}L+D$.

[3]This is a robust finding in other efficient bargaining models as well (Bentolia and Saint-Paul, 2003, p.14).
[4]This approach is similar to the derivation of the labor share by Jayadev (2007).

A rise in the outside option of the worker also leads to rise in the labor share, as long as employment is not reduced overproportionately as it is changed in order to adjust the marginal productivity of labor. If the outside option of the firm improves, the quasi-rent of the firm shrinks and the labor share should decrease. A change in the production technology or other input factors have unclear effects on the share as it depends on the specification of the production technology, most importantly on the marginal rate of substitution between the input factors.

Changes in openness of the economy have diverse effects on the labor share. Openness will affect the outside option of the firm and the level of competition on the product market. Increasing openness will most likely generate production opportunities under which firms will be able to offshore production processes or import intermediate inputs from abroad more easily. These opportunities signify an increase in the firms' outside option and will thus reduce the labor share ($\frac{\partial s_L}{\partial D} = -\alpha \frac{1}{PY} \leq 0$).

Furthermore, openness can lead to a change in the competition firms face in the product markets. Changes in product market competition can have manifold consequences on labor market outcomes. If competition in the product market in a closed economy is not perfect, the price P is not exogenous and constant, but a function of $F(K, L)$ and determined by product demand. Under these considerations equation (1) changes to

$$max_{w,L} \left(L \left(w - \overline{w} \right) \right)^{\alpha} \left(P \left(F \left(K, L \right) \right) F \left(K, L \right) - wL - rK - D \right)^{1-\alpha} \tag{8}$$

Under imperfect competition, the labor share from equation (6) the becomes:

$$s_L^{IC} = \alpha \left(1 - r \frac{K}{PY} - \frac{D}{PY} \right) + (1 - \alpha) \frac{F_L L}{Y} \left(1 - \frac{1}{|\eta_{Y,P}|} \right). \tag{9}$$

$\eta_{Y,P}$ is the product demand elasticity. As demand functions are usually negatively sloped, $\eta_{Y,P} < 0$ should hold. Under perfect competition every competitor faces a constant and fully elastic demand as the individual supply of the good is not able to change its price ($|\eta_{Y,P}| \rightarrow \infty$). The more inelastic the product demand function is, the higher is the price change due to a change in output. In this respect $|\eta_{Y,P}| \rightarrow 0$ can be associated with higher competition. From equation (9) it can be seen that less competition is associated with a lower labor share: $\frac{\partial s_L^{IC}}{\partial |\eta_{Y,P}|} > 0$ and $s_L \geq s_L^{IC}$.[5] Azmat et al. (2011) also find empirical indications that the labor share should increase if competition increases. Generally it is not clear in which direction opening markets will affect the labor share. It could be assumed that competition rises as barriers to trade are decreased. Yet, firms are also confronted with a larger number of customers. For individual firms or industries relative competition might decrease. Furthermore openness can induce selectivity as only the most productive or innovative firms survive and thus competition decreases eventually.

If there is a net demand increase for products from this economy after markets open, there might not only be a shift in the markup, but demand may shift outwards such that prices

[5] Arpaia et al. (2009), the European Commission (2007) and Bentolia and Saint-Paul (2003) discuss the influence of markups from the product market on the wage share in a closed economy. Only Arpaia et al. (2009) combine the markup and the bargaining decision although it is not clear how the markup is derived in the initial bargaining problem. Nevertheless they all also find a smaller wage share under less competition. Bentolia and Saint-Paul (2003) discuss how a markup affects the SK-schedule and finds that a markup puts the economy off the initial schedule if the markup moves over the business cycle. In the case of increasing economic integration the markup should shift more permanently to a higher or lower level.

and output should rise at the same time. The easiest case would be to analyze a shift from perfect competition in the closed market to a shift to perfect competition in the goods market while the input markets and thus their prices remain the same. As $\frac{\partial s_L}{\partial P} > 0$ the labor share would decrease if the international price level is below the prior domestic one in the closed market.[6] In order to analyze the case where total revenue changes and input prices remain constant, it is possible to redefine equation (5) as: $s_L = \alpha \frac{\pi}{pY} + (1-\alpha)\,\frac{\overline{w}L}{pY}$, where π, quasi-rent of the firm, is the firm's revenue minus non-labor input factors and its outside option. If π and L remain constant the labor share will decrease if total revenue increases. As the level of employment will most likely rise if output increases, the impact on the labor share and on π is again not clear anymore. If revenue increases more than capital used in production costs then π will increase. From these countervailing effects it is unclear it the labor share will increase or decrease under a net product market demand increase due to increasing openness. How production will react to this depends on the production function and input prices. Therefore it is unclear how changes in the size of the pie will affect the division of it.

So far, the bargaining process is treated as if everything is determined simultaneously. For this analysis it will make a differences what time horizon is considered. It is imaginable that investments into capital are already sunk when firms and workers bargain. In this case the quasi-rent of the firm, π, is reduced to revenue minus the outside option. This quasi-rent is clearly larger and the worker will be able to secure a larger part of total revenue. In the derivation of the labor share above, it is assumed that there are profits in the market, as revenue minus the costs of inputs has to be at least zero in order to not make any deficits. In the very short run, if costs for capital are sunk, workers may secure higher rents from the bargaining such that profits may be smaller than zero. Grout (1984) shows that the possibility of renegotiation of wages after capital investments are sunk may cause a disincentive to investment similar to a hold-up problem. How this underinvestment impact employment is discussed by Cahuc and Zylberberg (2004, p.414). If capital and labor are substitutes, underinvestment in capital will lead to increasing usage of labor in production while the opposite is true if both factors are complements. The case of sunk capital investments is also part of the model of Bental and Demougin (2010). Similar to the model by Grout (1984), Bental and Demougin (2010) discuss the impact of shifts of the bargaining power on the incentives to invest. When the workers have lower bargaining power the hold-up problem becomes less severe. Bentolia and Saint-Paul (2003) argue that, in the short-run, bargaining leads to a higher labor share through higher wages at constant employment, while the firms are able to adjust their capital stock in the long run and change employment accordingly. Clearly the workers cannot uphold rents that exceed profits longer than the very short run. Firms would shut down or will try to adjust the production technology to a less labor-intensive technology. Acemoglu (2002) explains how a wage push raises incentives for firms to invest into capital-biased technology in order to reduce labor demand in the long-run. Higher wages in the short-run may therefore lead to a lower labor share in the long-run.

[6] If the product demand elasticity is constant, $\frac{\partial s_L}{\partial P} = \alpha\left(\frac{rK}{p^2F} + \frac{D}{p^2F}\right)$.

2.2. Estimation Procedure

In the empirical part of the paper I investigate, in which way technology, institutions, and globalization have influenced the labor share in the short and longer run between 1980 and 2005. As discussed above, the determinants of the bargaining process can have different short- and long-run consequences on the labor share.

I estimate the long-run and short-run dynamics of these variables by an error-correction framework. This estimation technique allows for a long-run equilibrium between the dependent and independent variables and for an adjustment to this equilibrium after short-run deviations from it.[7] A derivation of this specification and variations of it can be found in Banerjee et al. (1993). Specifically, I estimate the following estimation equation[8]:

$$\Delta\, s_{L,\,ijt} = \alpha s_{L,\,ij,t-1} + \beta X_{ij,t-1} + \sum_{s=0}^{q} \gamma_s \Delta X_{ij,t-s} + \mu_{ij} + \epsilon_{ijt} \tag{11}$$

The dependent variable is the first difference of the labor share in country i and industry j at time t. The regressors are the lagged levels of the labor share, $s_{L,\,ij,t-1}$, the lagged levels of the independent variables $X_{ij,t-1}$, and lagged differences of the independent variables $\Delta X_{ij,t-s}$. The parameter on the lagged levels of the labor share, α, is the error-correction parameter, which indicates whether there are long-run relationships and how quickly the system returns to this after a shock. The parameters on the levels of the independent variables specify this long-run relationship between the labor share and the respective variable. The vector γ_s describes the short-run dynamic of an independent variable on the labor share. μ_{ij} is the industry-country specific effect and ϵ_{ijt} is the error term.

The regressors in X are chosen according to equation (7). Technology, $F(K,L)$ is represented by the capital-output ratio. In order to account for technological change and newer technologies, which may have a different level of substitutability with labor, the ICT-capital-output ratio is included as well. The outside-option of the worker, $\overline{w}$, is represented by unemployment benefits. Bargaining power is included by union coverage. As the unemployment rate influences the bargaining power of the workers and their outside option, it is also included. The outside option of the firm is represented by two kinds of openness indicators: trade flows and trade restrictions. A detailed description of the data is given in the next section.

[7]See Appendix B for a discussion of cointegration between the variables of this study.

[8]This error-correction specification is equivalent to the dynamic fixed effects specification of Blackburne III and Frank (2007):

$$\Delta\, y_{ijt} = \phi \left(y_{ij,t-1} - \theta' X_{ij,t-1} \right) + \sum_{s=0}^{q-1} \gamma_s \Delta X_{ij,t-s} + \mu_{ij} + \epsilon_{ijt} \tag{10}$$

The error-correction term, which mirrors the speed of adjustment from short run shocks to the long-run equilibrium, ϕ, is equal to α, the parameter on the lagged level of the dependent variable, in equation (11). The same long-run equilibrium parameters can be found if the parameter in θ are divided by ϕ. The parameters on the ΔX are identical in both methods.

3. The Data

The data used in this analysis is taken from different sources. The basic source is the EU KLEMS dataset in its version of March 2008.[9] This is a harmonized sectoral dataset from which the data on wages, employment, value added, capital measures, and deflators are taken. It covers the countries of the European Union and other advanced countries such as the US, Japan, or Australia, with comparable data across sectors, variable definitions and time. It was designed originally to measure economic growth and productivity. Thus, it includes many measures of different capital inputs as well as labor inputs for three skill-groups. The data originate from the individual statistical offices and were then harmonized to the same industry levels, reference years, and categorizations of capital and labor specifications by the EU KLEMS project. The coverage varies by country, by industry, and for the individual variables. The variables used in this study are listed in table C.1. The set of countries used in this study is listed in table C.2, the set of industries is described in table C.3. The 21 industries used here cover most of the countries' private economic activity including service sectors. Sectors which are mostly public or non-tradeable are left out of the analysis. This dataset is more homogeneous as the countries are rather with respect to technology, institutions, openness and the general wage setting conditions. As a robustness check, I later include data for Australia, Czech Republic, Japan, and the US as well as less tradeable, but private industries.

The labor share is defined as the total labor compensation over value added. The wage bill in the EU KLEMS is total labor compensation adjusted for the amount of self-employed, where it is assumed that the wage of self-employed equals the wage of employees in the same sector in the respective country. The labor share is not necessarily restricted to be between 0 and 1. In some circumstances the share can exceed total value added of the industry in some periods if there are losses in the period or if the income of self-employed is over estimated. Also subsidies may affect value added. EU KLEMS accounts for some subsidies such as price subsidies. Other subsidies are much harder to identify and to calculate into value added. In nine industry-country-combinations I found labor shares above one for more than 8 years which would be longer than a full business cycle. I leave this industry-country-combinations out of the analysis as they are likely to be subject to measurement errors. Table Appendix C shows the summary statistics for the labor share across industries. The labor share tends to be lowest in the Mining and Quarrying sector and Electricity, Gas, and Water Supply. The labor share in service sectors varies strongly from 2.4 to 166 percent of value added in the industry. Manufacturing is the largest subgroup and also contains very heterogeneous industries with respect to the labor share.

In order to find the driving forces of changes in the overall labor share and for a more detailed analysis, I also calculate the individual share of total value added that is payed out in wages to either high-skilled workers, medium- and low-skilled workers, or low-skilled workers only. For these variables I multiply the labor share with the relative compensation of workers of each skill group. The relative compensation shares are the shares of all wages and salaries including all costs that are covered by the employer of the respective skill group.

[9] Detailed information on the dataset can be found on the web page www.euklems.net or in Timmer et al. (2007a).

The skill groups are defined by the level of education of the workers. As educational systems vary across the relevant countries, the definitions of who belongs to which skill group differ slightly. Generally, workers with a college degree are counted as high-skilled workers, workers with upper secondary education, some college or a vocational degree are counted as medium-skilled, and workers with at most secondary education or no formal qualifications are counted as low-skilled workers.[10]

The data for technology variables, capital stock and ICT capital investments, are also taken from the EU KLEMS. Capital stocks are measured as the real gross fixed capital stocks of the industry. ICT-capital investments are defined as real gross fixed capital formation of ICT assets and are also provided on the industry level. ICT is considered as office and computing equipment, communication equipment, and software. The share of each kind of capital in value added varies tremendously across industries, but usually increases over the whole time frame. As table C.5 shows, both capital stock and ICT investment are either a fraction of value added or may even be as large as a multitude of the value added of the respective industry.

The remaining data on institutions, unemployment, and trade are on the country level. The data for trade flows and economic restrictions are taken from the KOF Index of Globalization by Dreher (2006). The KOF Index consists of three subcategories, economic globalization, social globalization, and political globalization. In this study I employ the two indexes of economic globalization: trade flows and trade restrictions. Both indexes are measured on a scale between 0 and 100 and increase with more openness (higher trade flows or less trade restrictions). The first, trade flows, is constructed from the classical openness variable, imports plus exports over GDP, as well as FDI, portfolio investments and income payments to foreign nationals. I refer to this variable as "openness". The index for restrictions on trade and capital is constructed from data on mean tariff rates, taxes on international trade, capital account restrictions, and hidden import barriers. This index is called "restrictions" in this study. It is based on indexes of rules and regulations, such as the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. It therefore measures rather capital account openness and potential openness with respect to flows. Although there exists some data for openness on a sectoral level in the OECD STAN database, the data quality is much better on the country level, as there are no missing values. The trade flows and restrictions give a broad picture of actual and potential openness of a country. They are correlated with 0.72, but, as the last lines of table C.5 show, the trade flows measure has a much larger variance for the countries and time frame of interest in this study.

The information about labor market institutions are again collected from different datasets. Unemployment benefits are the first-year gross replacement rates. The information of the gross replacement rates are taken from the FRDB Database of Structural Reforms (2010). Here, the first year gross replacement rates are used. Data on unemployment rates are taken from the KILM database of the ILO (2010). I use the data on union coverage from the ICTWSS of the University of Amsterdam (Visser, 2008).

[10] A detailed description of the definitions of skill levels for each country, as used in this study, can be found in Timmer et al. (2007b), page 28.

4. Empirical Results

In this section I first explore the impact of the various regressors on the labor share using country level data. This lets me compare the results to similar studies and indicates relationships of the regressors and the overall labor share which includes shifts between industries. Afterwards, I will come to the main results of the paper and investigate how the industry level labor shares are affected by the regressors, whether this is driven by individual skill-groups characteristics, and in which way the impacts differ between manufacturing and service industries.

4.1. Influences on the Country-Level

Similar to the studies by the European Commission (2007) and Checchi and Garcia-Penalosa (2010), I estimate the impact of the technological, institutional and trade influences at the labor share on a country level. The results are shown in table 1. The upper part of the table shows the long-run relationships between the labor share and the regressors, while the lower parts contain the short-run dynamics. These results are mostly in line with the studies by the European Commission (2007) and Checchi and Garcia-Penalosa (2010). An exception is the short-run positive impact of openness where the European Commission (2007) find a negative significant long-run impact. It should be noted, though, that the other studies only focus on the long-run effects in levels and leave short-run dynamics out of the picture.

The coefficient on $lns_{L,t-1}$ is equivalent to the error-correction speed of adjustment parameter. It is significant at any conventional level which indicates a long-run relationship between the regressors and the dependent variable. There is long-run positive coefficient for the capital-output ratio. This indicates a complementarity between capital and labor in production. The short-run impacts of the capital-output ratio can be found at the beginning of the lower part of the table. In the short-run the labor share also increases strongly after increased investments into capital, while after two periods the positive impact is partly reversed. This is explainable by the idea of sunk investment costs which were discussed at the end section 2.1. If capital and labor are complements and bargaining takes place after capital is invested, the labor share rises since the workers can then secure a high share of the rents under increased revenues with a higher output. Afterwards, employment and wages will be adjusted such that some of the increased rents will return to the capital owners.

ICT-capital seems to have a small and non-persistent positive short-run impact on the labor share in European countries on the country-level. Union coverage, on the other hand, has a persistent positive impact on the labor share as it stands for higher possible rents for workers due to higher bargaining power. Increases in unemployment benefits also has long- and short-run impacts on the labor share. The positive short-run dynamics could indicate a immediate increase in wages while employment is not adjusted immediately. In the long-run employment is then adjusted to the higher wages such that the labor share even decreases. Unemployment reduces the labor share in the short- and long-run. Thus, as cyclical increase in the unemployment rate decreases the labor share while high-persistent unemployment will also decrease the labor share in the long-run. Increases in trade flows increase the labor share with a one period lag, while trade restriction have no impact on the country level.

Table 1: Regression on the Country Level

Dependent Variable: First Difference of the Log Labor Share	
$ln\ s_{L,t-1}$ *	-0.360***
	(0.043)
$ln\ (K/Y)_{t-1}$	0.144***
	(0.043)
$ln\ \left(K^{ICT}/Y\right)_{t-1}$	-0.008
	(0.008)
$ln\ union_{t-1}$	0.043***
	(0.015)
$ln\ unben_{t-1}$	-0.008***
	(0.002)
$ln\ u_{t-1}$	-0.013*
	(0.007)
$ln\ rest_{t-1}$	-0.027
	(0.041)
$ln\ open_{t-1}$	-0.042**
	(0.018)
$\Delta\ ln\ (K/Y)_t$	0.692***
	(0.048)
$\Delta\ ln\ (K/Y)_{t-1}$	0.009
	(0.073)
$\Delta\ ln\ (K/Y)_{t-2}$	-0.207***
	(0.053)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_t$	-0.002
	(0.011)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-1}$	0.029**
	(0.012)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-2}$	0.011
	(0.015)
$\Delta\ ln\ union_t$	0.026
	(0.029)
$\Delta\ ln\ union_{t-1}$	0.117***
	(0.028)
$\Delta\ ln\ union_{t-2}$	0.039
	(0.026)
$\Delta\ ln\ unben_t$	-0.003**
	(0.001)
$\Delta\ ln\ unben_{t-1}$	0.006***
	(0.002)
$\Delta\ ln\ unben_{t-2}$	0.008***
	(0.002)
$\Delta\ ln\ u_t$	-0.022**
	(0.009)
$\Delta\ ln\ u_{t-1}$	-0.007
	(0.011)
$\Delta\ ln\ u_{t-2}$	-0.002
	(0.008)

Continued on next page

Table 1 – *continued from previous page*

$\Delta\ ln\ rest_t$	-0.007
	(0.049)
$\Delta\ ln\ rest_{t-1}$	0.010
	(0.059)
$\Delta\ ln\ rest_{t-2}$	-0.032
	(0.051)
$\Delta\ ln\ open_t$	-0.016
	(0.018)
$\Delta\ ln\ open_{t-1}$	0.038***
	(0.014)
$\Delta\ ln\ open_{t-2}$	0.020
	(0.019)
cons	-0.257
	(0.173)
$time - trend$	✓
$time - trend^2$	✓
N	157
r2	0.669

Cluster robust standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2. Influences on the Industry-Level

Table 2 shows the results for an within-industry (i. e. fixed effects) estimation which includes 21 tradeable industries in 9 European countries. The first column displays the results for the estimation on the industry-level labor share which are the main results. The next three columns have the same regressors, but the dependent variable is the labor share of a specific skill group. The last two columns contain results of separate estimations for the manufacturing and service sector. As there are differences in the tradeablity of output in manufacturing and services as well as in the institutional structures, such as higher union coverage in manufacturing, splitting the sample by sector may indicate how the regressors influence the labor shares in detail.

Table 2: Results for Main Regression, by Skill Group, and by Sector (Small Sample)

Dependent Variables: First Difference of the Log Labor Share of the industry, the Respective Skill Group, or Sector of industry j in country i						
	Overall	High	Med. & Low	Low	Manufacturing	Services
$ln\ s^i_{L,t-1}$	-0.295***	-0.198***	-0.278***	-0.134*	-0.318***	-0.239***
	(0.044)	(0.064)	(0.044)	(0.073)	(0.056)	(0.013)
$ln\ (K/Y)_{t-1}$	0.057*	0.037	0.067***	0.057*	0.055	0.073***
	(0.030)	(0.035)	(0.024)	(0.029)	(0.043)	(0.016)
$ln\ \left(K^{ICT}/Y\right)_{t-1}$	0.005	0.013	0.008	0.002	-0.002	0.015***
	(0.008)	(0.010)	(0.007)	(0.013)	(0.013)	(0.003)
$ln\ union_{t-1}$	0.025	-0.084***	0.041**	0.155***	0.017	0.044**
	(0.018)	(0.022)	(0.016)	(0.047)	(0.020)	(0.019)
$ln\ unben_{t-1}$	-0.001	-0.017**	0.003	-0.056**	-0.000	-0.002
	(0.002)	(0.007)	(0.003)	(0.025)	(0.003)	(0.003)
$ln\ u_{t-1}$	0.015	-0.011	0.000	0.011	0.017	0.010
	(0.014)	(0.015)	(0.012)	(0.017)	(0.018)	(0.009)
$ln\ rest_{t-1}$	-0.158**	-0.031	-0.105*	-0.177	-0.185**	-0.079
	(0.063)	(0.103)	(0.058)	(0.194)	(0.074)	(0.097)
$ln\ open_{t-1}$	-0.070**	-0.057	-0.062	0.037	-0.063**	-0.083**
	(0.033)	(0.056)	(0.046)	(0.081)	(0.032)	(0.041)
$\Delta\ ln\ (K/Y)_t$	0.335***	0.357***	0.334***	0.345***	0.331***	0.416***
	(0.110)	(0.107)	(0.111)	(0.119)	(0.122)	(0.038)
$\Delta\ ln\ (K/Y)_{t-1}$	0.123*	0.111	0.114	0.089	0.147**	-0.010
	(0.070)	(0.077)	(0.072)	(0.076)	(0.070)	(0.028)
$\Delta\ ln\ (K/Y)_{t-2}$	-0.015	-0.042	-0.027	-0.060	-0.008	-0.010
	(0.048)	(0.052)	(0.050)	(0.058)	(0.057)	(0.034)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_t$	-0.009	-0.028*	-0.003	-0.003	-0.013*	-0.006
	(0.007)	(0.017)	(0.008)	(0.014)	(0.008)	(0.005)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-1}$	-0.007	-0.011	-0.009	-0.007	-0.011	0.007
	(0.008)	(0.017)	(0.008)	(0.006)	(0.010)	(0.010)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-2}$	0.006	0.012**	0.006	0.016	0.010	-0.013
	(0.007)	(0.006)	(0.008)	(0.010)	(0.008)	(0.009)
$\Delta\ ln\ union_t$	0.095*	-0.259**	0.139***	0.310***	0.186***	-0.065
	(0.049)	(0.132)	(0.044)	(0.082)	(0.056)	(0.068)
$\Delta\ ln\ union_{t-1}$	0.219**	0.285**	0.164**	0.241	0.237*	0.214***
	(0.085)	(0.136)	(0.077)	(0.150)	(0.130)	(0.039)
$\Delta\ ln\ union_{t-2}$	0.050	-0.089	-0.013	0.368***	0.094	-0.033
	(0.061)	(0.142)	(0.057)	(0.142)	(0.084)	(0.045)
$\Delta\ ln\ unben_t$	0.002	0.007*	0.006	-0.015	0.009	-0.012**
	(0.005)	(0.004)	(0.004)	(0.015)	(0.006)	(0.005)
$\Delta\ ln\ unben_{t-1}$	0.008**	0.018*	0.008**	0.036**	0.006	0.012***
	(0.004)	(0.010)	(0.003)	(0.016)	(0.005)	(0.002)
$\Delta\ ln\ unben_{t-2}$	-0.002	0.009	-0.000	0.016*	-0.001	-0.004*
	(0.008)	(0.011)	(0.006)	(0.009)	(0.012)	(0.002)

Continued on next page

Table 2 – *continued from previous page*

	Overall	High	Med. & Low	Low	Manufacturing	Services
$\Delta\ ln\ u_t$	0.001	-0.016	-0.008	-0.012	0.011	-0.018
	(0.020)	(0.027)	(0.018)	(0.052)	(0.029)	(0.015)
$\Delta\ ln\ u_{t-1}$	-0.035*	0.039	-0.030	-0.026	-0.037	-0.027**
	(0.020)	(0.057)	(0.019)	(0.030)	(0.026)	(0.012)
$\Delta\ ln\ u_{t-2}$	-0.007	-0.005	0.005	-0.020	-0.001	-0.020*
	(0.020)	(0.049)	(0.019)	(0.020)	(0.028)	(0.011)
$\Delta\ ln\ rest_t$	-0.164**	0.163	-0.221***	-0.397*	-0.238**	-0.005
	(0.070)	(0.225)	(0.077)	(0.209)	(0.109)	(0.082)
$\Delta\ ln\ rest_{t-1}$	-0.047	-0.303	-0.055	-0.037	-0.096*	0.016
	(0.051)	(0.227)	(0.053)	(0.222)	(0.056)	(0.094)
$\Delta\ ln\ rest_{t-2}$	-0.021	0.175	-0.050	0.345	-0.083	0.108
	(0.081)	(0.201)	(0.075)	(0.393)	(0.115)	(0.080)
$\Delta\ ln\ open_t$	-0.074***	-0.114***	-0.061*	-0.000	-0.090***	-0.048
	(0.025)	(0.033)	(0.031)	(0.068)	(0.024)	(0.035)
$\Delta\ ln\ open_{t-1}$	0.030	-0.046	0.041	0.024	0.019	0.048**
	(0.026)	(0.097)	(0.030)	(0.062)	(0.036)	(0.020)
$\Delta\ ln\ open_{t-2}$	0.042***	0.027	0.053***	0.078*	0.037*	0.041**
	(0.014)	(0.048)	(0.014)	(0.046)	(0.020)	(0.020)
cons	0.678**	1.873***	2.949***	1.149	0.734**	0.505
	(0.268)	(0.716)	(0.541)	(1.001)	(0.305)	(0.386)
$time-trend$	✓	✓	✓	✓	✓	✓
$time-trend^2$	✓	✓	✓	✓	✓	✓
N	3259	3259	3259	3259	2160	1099
r2	0.299	0.220	0.288	0.266	0.304	0.334

Cluster robust standard errors in parentheses with two-way clustering on country and industry-country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Within-Industry Estimation

For the overall labor share the error-correction adjustment term is again significant and negative and has roughly the same size as for the country-level regression. There is a significant positive coefficient for the capital-labor ratio which indicates a persistent complementary relationship of the two input factors. This is clearly in line with SK-schedule described by Bentolia and Saint-Paul (2003), although they find indications of substitutability between capital and labor rather than complementarity. Furthermore, economic openness has strong persistent influences on the labor share. A reduction in trade restrictions (*ln rest* increases) as well as increasing trade flows both decrease the labor share in the long-run. As described in the theory part, this can be due to an improving outside option of the firm and thus substitutability of workers across countries, or due to weakened competition on the product market. The coefficient on the long-run restriction variable is quite large. Here it has to be taken into account that this variable increases roughly a quarter to a third between 1980 and 2005 while openness, which signifies trade flows, doubles or tripled for most countries. Both globalization variables also have short-run dynamics on the labor share. A decrease in restrictions has an immediate negative impact on the labor share, while the very first negative impact of increasing trade flows is dampened by a positive lagged impact which is about the same size.

Union coverage, unemployment benefits, and the unemployment rate have only short-run dynamic effects on the labor share on the industry-level. As expected union coverage has a positive influence and this is strongest one period after the increase. Unemployment benefits have a smaller, but still positive impact on the labor share. This positive impact of the outside option of the worker is also lagged one period. A higher unemployment rate decreases the labor share one period later. As both, the labor share and the unemployment rate, tend to be countercyclical,[11] this estimation indicates that an increase in the unemployment rate will dampen the countercyclical movement of the labor share. An explanation would be that an increase in the unemployment rate will clearly have less people employed and the ones who are employed ask for lower wages.

Within-Industry Estimation for Separate Skill Groups

All influences of the labor share, discussed in this study may have a different effect for each skill-group. Technological progress may be skill-biased and also trade may affect the labor market outcomes workers differently depending on their skills and productivity.[12] As technology may be complementary to some skills and substitutes to others or labor market institutions favoring specific worker groups, differences in the regressions can be expected. The literature concerned with skill-biased technological change assumed a linear relationship between skill and technological progress in ICT. Here it is assumed that low-skilled work is a substitute to technology while high-skilled work in complementary. Checchi and Garcia-Penalosa (2010) assume this even for non-ICT capital. A more recent literature is concerned with substitution of work at the middle of the income and skill distribution. This literature argues that specific tasks are substitutes to ICT, which are mostly prevalent in medium-skilled work. The result for high-skilled workers' labor share can be found in the second column of table 2, for medium and low-skilled in column three, and only for low-skilled only in the last column.

The results show remarkable differences between the skill-groups. The high-skilled labor share has no long-run relationship with technological or trade variables. Only labor market institutions seem to have lasting and negative influences on the labor share of high-skilled. Union coverage has a negative long-run influence on the labor share although it should represent bargaining power. This can be explained by the tendencies of unions to compress wages and decrease wage inequality in unionized settings (Acemoglu et al., 2001). Indeed there is a stronger positive impact on union coverage on the labor share for low-skilled and only much smaller effects in the estimation for medium and low-skilled labor share. Thus, although union coverage has a strong connection to the labor share for individual skill groups, the effect levels out between the group such that it disappears on the aggregate level. Unemployment benefits also reduce the labor share in the long-run although its short-run dynamic is positive. This indicates that at first wages increase due to a higher alternative wage, $\overline{w}$, but in the longer-run employment is adjusted such that the labor share decreases. As low-skilled workers' wages tend to be smaller, the outside option of unemployment benefits should have

[11] C.f. European Commission (2007), Choi and Ríos-Rull (2009), or Ríos-Rull and Santaeulàlia-Llopis (2010).

[12] For a review on skill-biased technological change see Katz and Autor (1999), Braun et al. (2009), or Acemoglu and Autor (2011) for a more recent approach. A survey on the impact of international trade on labor markets can be found in Johnson and Stafford (1999).

a higher probability to be binding and thus their coefficient should be larger, which is indeed the case.

Although high-skilled workers' labor share has no significant long-run relationship with the capital-output ratio, the immediate impact of an increase in the capital-output ratio is highly positive and significant and also very close to the impact it has on the labor share of workers with less education. For the high-skilled, ICT-investments reduce the labor share in the beginning, but weakens the impact through a smaller positive impact after two periods. The long-run relationship, which mirrors the SK-schedule is significant for the medium and low-skilled workers. The results indicate that medium and low-skilled work is complementary to capital. Even though ICT-investments have no long-run impact on the labor share, the significant negative short-run dynamic for the high-skilled is interesting as it is usually assumed that ICT is skill biased towards high-skilled workers, while it substitutes low-skilled work.

Differences between skill groups can also be found for the impact of economic openness on the respective labor shares. While there are strong negative long-run impacts of trade flows and restrictions for the overall labor share, a negative significant impact is only found for decreasing trade restrictions on the medium and low-skilled labor share. No other coefficients for the long-term impacts are significant. Decreasing trade restrictions have an immediate negative impact on the labor share for medium and low-skilled workers. Especially the coefficient for trade restrictions on the low-skilled labor share is large. While a reduction in barriers to trade, such as decreasing import barriers and taxes on trade or increasing capital account openness, affects mostly medium and low-skilled workers' labor share, increasing trade flows influence the high-skilled workers' labor share negatively. Trade flows reduce the high-skilled workers' share in the first period, but become insignificant thereafter and in the long-run. The medium and low-skilled workers' share is also reduced at first, but this effect is almost undone two periods later when openness increases the share again. For low-skilled workers trade openness has only a positive impact on their share two periods after an increase. For both openness variables the negative effects on the separate skill groups outweigh potential positive effect, as the overall long-run impact and the very short-run dynamics are negative.

Within-Industry Estimation for Manufacturing and Services

Next to differences in the influences on the bargaining outcome for the skill groups, bargaining outcomes may vary between sectors. Tradeable industries in manufacturing are likely to differ in the wage and employment setting mechanisms from service industries. I therefore estimate the error-correction model individually for tradeable manufacturing and tradeable service industries in Europe. The estimation results can be found in the last two columns of table 2.

Although the coefficient for the long-run relationship between capital and the labor share are similar and positive in both regressions, it is only significant for the service industries. The short-run dynamics also indicate capital-labor complementarity. While for services the first-year effect is stronger, increasing the capital stock relative to output has a significant positive impact for the following two periods. The negative third period effect of the capital-output ratio on the labor share which was observable in the country level regression of the last column in table 1 has not been significant for any industry-panel regression. ICT-capital investments have very different impact in services compared to manufacturing. In services, ICT-investments increase the labor share in the long-run and thus are complementary to labor while in manufacturing increases in ICT have an immediate negative impact. In manufacturing there is an short-run substitution effect without long-run consequences for the labor share.

Surprisingly, unions have a long-run positive impact only in services although union coverage tends to be higher in manufacturing (Machin, 2000). Nevertheless, an increase of bargaining power due to an increase in coverage has a positive short-run impact for the labor share in both sectors.

Trade integration has negative long-run impacts on the labor share in services and manufacturing although decreasing trade restrictions only affect manufacturing industries. This negative impact is observable in the short- and in the long-run. Increasing trade flows have long-run negative impact in both sectors while the short-run dynamics differ. In manufacturing increasing trade flows first decrease the labor share, but this dampened is in the third period by a smaller increase. The short-run dynamics in services, on the other hand, are positive.

Wage Markups in Europe

The outside option for the firm under trade openness is more valuable if wages in countries with similarly skilled workers are lower. Therefore, I include a measurement for the wage-markup of industry j in country i compared to industry j in all other European countries.

$$ln\ markup_{ijt} = ln\left(\frac{w_{ijt}}{\frac{1}{I}\sum_i w_{ijt}}\right) \tag{12}$$

where w is the average hourly wage of industry j in country i and $I = \sum i$.

Having similar educational backgrounds across Europe, a higher markup for a country, raises incentives for firms to offshore production to another European country. A higher markup is therefore expected to lower the bargaining outcome for workers. If wages are much higher in the respective country, workers should have an incentive to reduce wages in order to keep the production process at home. In the long-run wages should therefore equalize if labor is homogeneous across countries and barriers to trade are reduced.

The wage markup is endogenous in the estimation as the wage w appears on the left side of the equation in the labor share, ($s_L = wL/Y$), and on the right side in the markup. I therefore construct an instrument. It is the average hourly wage of industry j in Europe[13] excluding the respective country at time t.

$$instrument_{ijt} = \frac{1}{I-1}\sum_{i \backslash m} w_{ijt} \tag{13}$$

Table 3 shows the estimation with a markup in the first column and the IV regression in the second. The first column shows how including wages biases the regression coefficients. Under the IV estimation the coefficients return to the values and significance levels as in the baseline regression of the first column in table 2. The dynamics of the markup coefficients show that higher wages compared to other countries lead to a lower bargaining outcome over the labor share for workers.[14] This will hence indeed lead to an equalization of wages in the

[13] For the construction of this variable I calculate the average industry wages for all European countries which are available in the EU KLEMS at time t.

[14] In this estimation a level effect of the markup is not included as wages should equalize in the long run.

European countries.

Table 3: Markup and IV Regression

Dependent Variable: First Difference of the Log Labor Share		
	Markup	IV
$ln\ s_{L,t-1}$	-0.194***	-0.305***
	(0.021)	(0.049)
$ln\ (K/Y)_{t-1}$	0.048*	0.061**
	(0.028)	(0.029)
$ln\ \left(K^{ICT}/Y\right)_{t-1}$	0.005	0.004
	(0.008)	(0.007)
$ln\ union_{t-1}$	0.018	0.032*
	(0.015)	(0.019)
$ln\ unben_{t-1}$	-0.004	0.003
	(0.003)	(0.002)
$ln\ u_{t-1}$	0.020*	0.022
	(0.011)	(0.014)
$ln\ rest_{t-1}$	-0.107	-0.162***
	(0.070)	(0.054)
$ln\ open_{t-1}$	-0.029	-0.136***
	(0.040)	(0.045)
$\Delta\ ln\ markup_t$	0.370***	-0.136***
	(0.058)	(0.046)
$\Delta\ ln\ markup_{t-1}$	-0.079***	-0.114***
	(0.022)	(0.033)
$\Delta\ ln\ markup_{t-2}$	-0.001	-0.014
	(0.029)	(0.042)
$\Delta\ ln\ (K/Y)_t$	0.549***	0.260**
	(0.068)	(0.120)
$\Delta\ ln\ (K/Y)_{t-1}$	0.014	0.078
	(0.033)	(0.067)
$\Delta\ ln\ (K/Y)_{t-2}$	-0.058	-0.002
	(0.038)	(0.058)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_t$	-0.021***	-0.005
	(0.007)	(0.008)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-1}$	-0.001	-0.004
	(0.006)	(0.009)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-2}$	0.009	0.007
	(0.007)	(0.008)
$\Delta\ ln\ union_t$	0.090	0.124
	(0.092)	(0.081)
$\Delta\ ln\ union_{t-1}$	0.107	0.239***
	(0.086)	(0.082)
$\Delta\ ln\ union_{t-2}$	0.115**	0.022
	(0.048)	(0.054)

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If it is included, the coefficients and significance levels of all other coefficients remain the same while the coefficient on the level variable is small and highly insignificant.

Table 3 – *continued from previous page*

	Markup	IV
Δ *ln* $unben_t$	-0.004	0.001
	(0.006)	(0.005)
Δ *ln* $unben_{t-1}$	0.008*	0.007*
	(0.004)	(0.004)
Δ *ln* $unben_{t-2}$	0.004	-0.004
	(0.006)	(0.009)
Δ *ln* u_t	-0.000	0.012
	(0.020)	(0.020)
Δ *ln* u_{t-1}	-0.011	-0.051**
	(0.019)	(0.026)
Δ *ln* u_{t-2}	-0.064***	0.007
	(0.022)	(0.022)
Δ *ln* $rest_t$	0.008	-0.186**
	(0.119)	(0.079)
Δ *ln* $rest_{t-1}$	-0.052	-0.097
	(0.092)	(0.081)
Δ *ln* $rest_{t-2}$	0.178*	-0.104
	(0.094)	(0.110)
Δ *ln* $open_t$	-0.001	-0.125***
	(0.035)	(0.040)
Δ *ln* $open_{t-1}$	0.065***	0.012
	(0.021)	(0.026)
Δ *ln* $open_{t-2}$	-0.045	0.065***
	(0.049)	(0.023)
cons	0.418	0.842***
	(0.287)	(0.258)
$time - trend$	✓	✓
$time - trend^2$	✓	✓
N	3259	3259
r2	0.508	0.158

Cluster robust standard errors in parentheses with two-way clustering on country and industry-country level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Interaction between ICT-Investments and Globalization

The trade literature traditionally asks the questions under which circumstances a firm decides to offshore production through offshore outsourcing or FDI. Grossman and Rossi-Hansberg (2008) discuss how technological progress in transportation as well as in ICT raise incentives to separate production processes across economies. ICT enables communication with offshored subsidiaries, enables service offshoring, lowers transportation costs especially for services and increases monitoring possibilities (Braun et al., 2009, Part II). As economic openness and ICT are closely interconnected, it is interesting to study both impacts on the labor share together. Table 4 shows the within-industry correlations between ICT-investments and trade flows and trade restrictions respectively. ICT-investments and flows have positive correlation which is significant on any conventional level. The correlation between ICT-investments and

Table 4: Fixed Effects Regression of ICT on Openness

Dependent Variable: Log of Trade Flows and Log of Trade Restrictions		
	ln open	*ln rest*
$ln\ \left(K^{ICT}/Y\right)$	0.169***	0.067***
	(0.033)	(0.012)
cons	4.776***	4.711***
	(0.129)	(0.0446)
N	4045	4045
r2	0.512	0.569

Clustered standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

trade restrictions, which is rather a measurement for potential openness, is similarly positive and significant, only somewhat smaller. These results imply that the regression results for the openness variables include variation from ICT investments. Next, I estimate the error-correction model and interact both globalization variables with investments in ICT to be able to distinguish between individual and joint effects of the variables on the labor share.

Table 5 shows the results of the interactions. In the first column the variable trade restriction is interacted with the ICT-investments-output ratio. This regression shows a strong interconnection between the reduction of trade restrictions and ICT-investments in their impact on the labor share. A simultaneous increase in both has a long-run negative and significant impact on the labor share. The long-run individual impact of decreasing trade restrictions is actually more than twice the size of the negative coefficient without the interaction. The results also show a long-run complementarity between labor and ICT-capital. Without the common variation between ICT-capital investments and restrictions on economic openness the impact of ICT-investments on the labor share is positive and large in the long-run dynamics. All short-run dynamics of restrictions and ICT-investments become insignificant with the interactions. These results imply that ICT-investments have a negative impact on the labor share in that they enable offshoring and relocation of production processes abroad. The negative common impact of the interaction show how ICT decreases the labor share through an improvement of the outside option of the firm (D increases). The direct technological impact increases the labor share as it is labor augmenting.

Table 5: Interactions Between Globalization and ICT

Dependent Variable: First Difference of the Log Labor Share Estimation for Europe				
	ICT & Rest.	ICT & Open.	ICT & Rest.	
	Full Sample		Services	Med.+Low
$ln\ s_{L,t-1}$	-0.297***	-0.296***	-0.244***	-0.285***
	(0.045)	(0.045)	(0.014)	(0.045)
$ln\ \left(K^{ICT}/Y\right)_{t-1} * ln\ rest_{t-1}$	-0.053**		-0.049**	-0.083***
	(0.022)		(0.021)	(0.029)
$ln\ \left(K^{ICT}/Y\right)_{t-1} * ln\ open_{t-1}$		-0.012		
		(0.012)		
$ln\ (K/Y)_{t-1}$	0.057*	0.058*	0.075***	0.068***
	(0.031)	(0.031)	(0.017)	(0.026)
$ln\ \left(K^{ICT}/Y\right)_{t-1}$	0.241**	0.051	0.224**	0.373***
	(0.094)	(0.040)	(0.093)	(0.127)
$ln\ union_{t-1}$	0.023	0.029	0.043**	0.037**
	(0.019)	(0.022)	(0.017)	(0.016)
$ln\ unben_{t-1}$	-0.003	-0.003	-0.005*	-0.000
	(0.003)	(0.003)	(0.003)	(0.002)
$ln\ u_{t-1}$	0.011	0.011	0.005	-0.006
	(0.015)	(0.014)	(0.009)	(0.013)
$ln\ rest_{t-1}$	-0.356**	-0.154**	-0.267*	-0.419***
	(0.142)	(0.066)	(0.149)	(0.151)
$ln\ open_{t-1}$	-0.062*	-0.117*	-0.075**	-0.049
	(0.032)	(0.069)	(0.037)	(0.044)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t} * ln\ rest_{t}$	-0.124		-0.034	-0.148
	(0.116)		(0.066)	(0.127)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-1} * ln\ rest_{t-1}$	0.015		0.137	0.012
	(0.066)		(0.087)	(0.062)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-2} * ln\ rest_{t-2}$	0.029		0.063	0.041
	(0.083)		(0.041)	(0.074)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t} * ln\ open_{t}$		-0.004		
		(0.019)		
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-1} * ln\ open_{t-1}$		0.012		
		(0.019)		
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-2} * ln\ open_{t-2}$		0.004		
		(0.008)		
$\Delta\ ln\ (K/Y)_{t}$	0.336***	0.336***	0.414***	0.336***
	(0.108)	(0.110)	(0.039)	(0.109)
$\Delta\ ln\ (K/Y)_{t-1}$	0.125*	0.125*	-0.009	0.117
	(0.070)	(0.070)	(0.028)	(0.071)
$\Delta\ ln\ (K/Y)_{t-2}$	-0.015	-0.014	-0.005	-0.025
	(0.049)	(0.048)	(0.035)	(0.051)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t}$	0.548	0.008	0.145	0.659
	(0.526)	(0.079)	(0.297)	(0.577)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-1}$	-0.071	-0.055	-0.604	-0.061
	(0.294)	(0.074)	(0.388)	(0.277)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-2}$	-0.123	-0.010	-0.294	-0.176
	(0.367)	(0.030)	(0.184)	(0.326)

Continued on next page

Table 5 – *continued from previous page*

	ICT & Rest.	ICT & Open.	ICT & Rest.	
	Full Sample		Services	Med.+Low
Δ *ln* $union_t$	0.099**	0.093**	-0.063	0.143***
	(0.047)	(0.047)	(0.069)	(0.041)
Δ *ln* $union_{t-1}$	0.226**	0.218***	0.222***	0.178**
	(0.090)	(0.080)	(0.040)	(0.079)
Δ *ln* $union_{t-2}$	0.061	0.047	-0.017	0.006
	(0.072)	(0.061)	(0.041)	(0.069)
Δ *ln* $unben_t$	0.001	0.001	-0.013**	0.005
	(0.004)	(0.006)	(0.006)	(0.004)
Δ *ln* $unben_{t-1}$	0.011***	0.009**	0.014***	0.011***
	(0.004)	(0.004)	(0.002)	(0.004)
Δ *ln* $unben_{t-2}$	-0.000	-0.002	-0.004	0.002
	(0.007)	(0.008)	(0.002)	(0.005)
Δ *ln* u_t	-0.003	-0.002	-0.023	-0.015
	(0.019)	(0.018)	(0.015)	(0.016)
Δ *ln* u_{t-1}	-0.035*	-0.033*	-0.027**	-0.030*
	(0.019)	(0.019)	(0.012)	(0.017)
Δ *ln* u_{t-2}	-0.005	-0.005	-0.017*	0.007
	(0.019)	(0.020)	(0.009)	(0.018)
Δ *ln* $rest_t$	-0.554	-0.151**	-0.084	-0.682
	(0.395)	(0.062)	(0.217)	(0.449)
Δ *ln* $rest_{t-1}$	0.018	-0.047	0.435	0.015
	(0.247)	(0.050)	(0.274)	(0.235)
Δ *ln* $rest_{t-2}$	0.092	-0.013	0.348**	0.118
	(0.288)	(0.086)	(0.147)	(0.249)
Δ *ln* $open_t$	-0.073***	-0.092	-0.052	-0.061*
	(0.027)	(0.088)	(0.034)	(0.033)
Δ *ln* $open_{t-1}$	0.028	0.077	0.037**	0.038
	(0.025)	(0.091)	(0.018)	(0.028)
Δ *ln* $open_{t-2}$	0.038**	0.061	0.037**	0.047***
	(0.015)	(0.045)	(0.018)	(0.013)
cons	1.555***	0.841**	1.312**	4.398***
	(0.552)	(0.332)	(0.626)	(0.912)
$time - trend$	✓	✓	✓	✓
$time - trend^2$	✓	✓	✓	✓
N	3259	3259	1099	3259
r2	0.301	0.299	0.342	0.293

Cluster robust standard errors in parentheses with two-way clustering on country and industry-country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Trade flows and ICT, on the other hand, seem to have no common impact on the labor share in this sample. The results of their interaction can be found in the second column of table 5. The common coefficient is insignificant for the long-run as well as the short-run dynamics. The individual impacts of ICT remain insignificant and the coefficients for openness are hardly affected by the interaction.[15] As mentioned above, this is not surprising as the impact of

[15]These results seem to hold only for Western Europe. Including the Australia, Japan, the Czech Republic, and the US the effect disappears, even if only the 21 tradeable industries are considered. Furthermore, if ICT

ICT on trade flows is already realized when trade takes place and therefore included in flows variable.

In order to find out if the results for the common impact of restrictions and ICT are driven by a sector or skill-group, I reestimate the regression for manufacturing and services separately and then for the individual skill groups. With respect to sectors, the common impact is mostly observable in the service sector. The estimation results for services are given in the third column of table 5. The coefficients for the common impact and the individual impacts are a bit smaller, but very similar and significant. The interaction variable has no significant results for manufacturing. Similarly, high and low-skilled worker seem to be not affected by the interaction, but for medium-skilled workers the impact is even much larger than in the overall regression. The results show that especially medium-skilled work is complementary to ICT, but they are also most threatened to loose shares of the overall income due to increasing capital mobility and economic integration.

Robustness: Estimation for Large Dataset

In order to find out how generalizable the Western European results are for other countries and more industries, I estimate the error-correction model for the large sample which includes Australia, the Czech Republic, Japan, and the US as well as other private sector industries which are less tradeable (see tables C.2 and C.3 for details on the large dataset). Tables D.6 shows the estimation results.

The baseline results in column one of table D.6 show very similar estimation results to the smaller sample. The coefficients on the capital-output ratio are a bit smaller and the short-run first period impact of ICT-capital investments are negative and significant. Unions have a smaller coefficient for the short-run dynamics, while they have a small but significant coefficient for the long-run impact. The coefficients for trade flows are a bit smaller, but most interestingly the coefficient for the long-run impact of trade restrictions much smaller and no longer significant. Across these heterogeneous industries and countries, economic globalization has only a long-run negative impact on the labor share through trade flows.

The results for the different skill groups are also similar to the ones from the smaller dataset. Regarding trade openness, a reduction in trade barriers has no long-run impact on the labor shares of any skill group in the large dataset. It only has an immediate negative impact on medium and low-skilled workers. Trade flows reduce the labor share of high and medium-skilled workers in the long-run, but has only significant negative short-run dynamics for medium-skilled workers.

Differences in large dataset compared to the baseline dataset with respect to manufacturing and services are apparent in the findings for ICT-capital investments, unemployment benefits, and economic globalization. ICT-capital investments only have an impact on the labor share in manufacturing in the larger dataset. Here it decreases the labor share in first periods after an increase, but has no lasting impact in the long-run. Unemployment benefits have countervailing effects in manufacturing and services. In levels and at impact, an increase

and trade flows are interacted, the interaction term is positive while the ICT-output ratio is negative. This would indicate a substitutability of ICT investments to labor in these countries. The aforementioned results for Western Europe hold also if industries which are less tradeable are included, although the coefficients are smaller and significant on a lower level.

in unemployment benefits increases the labor share in manufacturing, but it is decreased in services. This could indicate a more elastic labor demand in services on average in the larger dataset. In this dataset both openness variables have no impact on the labor share in services. In manufacturing and services both variables have a negative first period effect after an increase and trade flow reduce the labor share in manufacturing in the long-run as well. Here the coefficient is even larger than in the baseline dataset. Although economic integration has a common impact on the labor share in manufacturing, in services the impact depends on the specific industries and countries. In more tradeable industries and within Western Europe openness influences the bargaining outcome, while in other countries and more local service industries this is not observable.

Robustness: Structural Break

The mid 1990s were characterized by changes in the regulatory frameworks of international trade and economic integration as well as in technological progress. In 1993, the European internal market was finalized and the Maastricht Treaty came into effect. The Schengen Agreement was implemented in 1995, the same year the Uruguay round of the GATT ended and the WTO was founded. These regulations are intended to decrease barriers to trade, to integrate markets and increase competition. This will most likely have an impact on the labor markets as well. Furthermore, as Jorgenson (2001) discusses how from 1995 onwards, prices for semiconductors decreased and investments into ICT accelerated. Firpo et al. (2011) find changes in the impact of technology and trade on the occupational wage structure of men in the US between the 1980s, 1990s and 2000s. Therefore, it may be the case that the aforementioned results were mostly driven by the later or earlier period and that the results are not robust over time. I estimate the error-correction model by interacting all variables with dummies for the time period prior to 1994 and dummies for the time afterwards. The results can be found in table D.7. I test for significant differences between the coefficients and indicate those by italic font.

It has to be taken into account that under split time periods the years of observation are very few to estimate long-run effects. There are hardly two business cycles in the estimation periods if the sample is split in 1994. For economic openness there are only a few significant differences between the two time periods. In manufacturing the negative impact of decreasing trade restrictions on the labor share intensifies in the short-run dynamics which has in effect on the aggregate estimation as well. Increasing trade flows increase the labor share in services in the short-run in the later period. The negative long-run impact remains. The influence of ICT-investments on the labor share changes mostly in the dynamics. A significant negative impact in the second period after an increase changed to a reduction of the labor share in the first period and an increase in the third for manufacturing and the overall labor share. In services an increase in ICT-investments decreases the labor share immediately in the later period while it was insignificant in the earlier period. An interesting observation is the change in the influence of unions on the labor share between the two periods. In manufacturing the positive long-run influence of higher union coverage on the labor share plummeted and became insignificant. In services union coverage became significant in the long-run only in the later period. As the time periods are very short for an error-correction framework, it is difficult to weigh these results very much. Nevertheless, there seems to be no drastic change in the relationship between economic openness and the labor share as well as between ICT-investments and the labor share in the two sub periods.

5. Conclusion

Increasing economic integration, frequent advances in information, and communication technology as well as changes in institutions have affected markets around the globe. How these changes have influenced labor markets in developed countries is of particular interest for researchers as well as policy makers. Governments have to come up with measures that secure competition and keep production local while ensuring that workers earn sufficiently and unemployment stays low. Implementing the appropriate measures demands a thorough understanding of the dynamics at hand. This paper aims at shedding light on these dynamics concerning the division of income between capital and labor.

The influences on the labor share are investigated by looking at short and long-run dynamics between 1980 and 2005. I show differences between the estimation on country and industry level. While estimating on a country level, which includes shifts in the sectoral composition within an economy, the labor shares in Western Europe are mostly influenced by the capital stock and labor market institutions as well as trade flows in the long-run. Analyzing labor shares on an industry level shows that institutions are less important overall for the distribution of income between capital and labor, but play a higher role in the distribution of income between skill groups. On an industry-level, the capital stock and economic integration determine the movements of the labor share in the long-run. The distributive impact of labor market institutions on the labor share for the different skill groups implies a compressionary impact of union involvement on the wage distribution. Unemployment benefits increase the labor share in the short-run, but as employment is adjusted, it has a negative impact on the long-run labor share which is especially strong for low-skilled workers. Contrary to studies of the European Commission (2007) or Arpaia et al. (2009), low and medium-skilled work are also found to be complementary to capital. The coefficients for the capital-output ratio are highly positive and similar for all skill groups.

The impact of globalization on the labor share is large and significantly negative in the short as well as the long-run. I use two kinds of measures for economic globalization. One accounts for trade flows, the other for a reduction in trade restrictions including capital account openness. On the industry-level, trade flows lower the labor share in the long-run significantly and trade-flows and decreasing trade restrictions also have negative short-run influences on the labor share. With respect to different skill groups, trade flows seem to affect rather the high and medium-skilled workers while medium and low-skilled workers labor shares are influenced by decreasing restrictions and capital market integration to a larger extend. Regarding manufacturing and services separately, the labor share in manufacturing industries are affected by both forms of economic integration in the short-run and strongly by increasing trade flows in the long-run. Services seem unaffected by economic integration on first sight. Correcting for common variation between technological advances in information and communication technology (ICT) and economic globalization shows that ICT enables economic integration and thus influences the labor share negatively. ICT-capital itself is complementary to labor and increases the labor share. This holds for Western Europe and especially for the service sector and medium-skilled workers' labor shares.

This result is especially interesting in the light of the labor market literature finding a polarization in many western economies. This polarization indicates decreasing wages for medium-skilled workers and workers who are in the middle of the wage distribution in general. Goos and Manning (2007) find such a polarization for the UK and Spitz-Oener (2006) and Dustmann et al. (2009) for Germany. These studies argue that the polarization is most likely due to innovations in ICT which complement specific tasks such as interactive and non-routine tasks and substitute routine tasks, which have a high fraction of total tasks in medium-skilled work. Autor et al. (2008) argue similarly for the observed polarization in the US, but also mention possible connections between ICT innovations and increasing economic integration. Grossman and Rossi-Hansberg (2008) translate the idea of tasks to the trade literature. Here specific tasks are more easily tradeable than others. Costinot et al. (2009) show that these tasks are indeed the ones which are more routine. Firpo et al. (2011) conclude from their analysis that both, ICT and trade, account an increasing polarization in the US, while ICT had it largest impact until the 1990s and trade became more important since the the 1990s. Labor market literature and trade literature thus propose two sources of pressure on the labor share of medium-skilled workers. My results indicate that for Western European countries the threat of substitution through ICT is *not* the driving force of the observed polarization. It is rather the threat to offshore production processes, which employ tasks that tend to be performed by medium-skilled and thus substitute local labor with foreign labor, that may cause the polarization.

Michael Spence recently wrote an article on "The Impact of Globalization on Income and Employment" in the US (Spence, 2011). He focuses on the substantial impact of economic integration in tradeable sectors which affects the whole working population in the US and has distributive implications. He urges policy makers in the US to address this issue which will remain after the current economic crises recede. The same applies to Western European policy makers as increasing globalization affects the distribution of income between capital and labor. As I show, wages in Europe will become more similar and workers in high-wage countries are confronted with lower wages or less employment if work is substitutable across countries. This paper shows a negative impact of economic integration on the labor share, but it cannot identify the specific causes. It will be necessary to investigate on a micro-level how much the negative impact originates from improvements of the outside option of the firms and how much other factors, such as decreases in competition and higher monopoly rents, cause this dynamic. Each cause will demand a different action in order to ensure sustainable incomes and employment in Western European countries for all workers.

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Appendix A. Derivation of Equation (9)

$$max_{w,L}\left(L\left(w-\overline{w}\right)\right)^{\alpha}\left(P\left(F\left(K,L\right)\right)F\left(K,L\right)-wL-rK-D\right)^{1-\alpha}$$

First Order Condition with respect to L, where $P=P\left(F\right)$ and $F=F\left(K,L\right)$:

$$\alpha\left(PF-wL-rK-D\right)=\left(1-\alpha\right)\left(w-\frac{\partial P}{\partial F}\frac{\partial F}{\partial L}F-\frac{\partial F}{\partial L}P\right)L$$

Augment this with $\frac{P}{P}$

$$\alpha\left(PF-wL-rK-D\right)=\left(1-\alpha\right)\left(w-\frac{\partial P}{\partial F}\frac{P}{P}\frac{\partial F}{\partial L}F-\frac{\partial F}{\partial L}P\right)L$$

Define the inverse of the product demand elasticity: $\frac{\partial P}{\partial F}\frac{F}{P}=\mu$.

$$\alpha\left(PF-wL-rK-D\right)=\left(1-\alpha\right)\left(w-\mu\frac{\partial F}{\partial L}P-\frac{\partial F}{\partial L}P\right)L$$

$$\alpha\left(PF-wL-rK-D\right)=\left(1-\alpha\right)\left(w-(1+\mu)\frac{\partial F}{\partial L}P\right)L$$

$$wL=\alpha\left(PF-rK-D\right)+P\frac{\partial F}{\partial L}L(1+\mu)$$

Divide this by total revenue: PY, and replace μ by its inverse, the product demand elasticity $|\eta_{Y,P}|$

$$s_L^{IC}=\alpha\left(1-\frac{rK}{PY}-\frac{D}{PY}\right)+\frac{\frac{\partial F}{\partial L}}{F}L(1-\frac{1}{|\eta_{Y,P}|})$$

Appendix B. Error-Correction, Unit Roots, and the Labor Share

Error-Correction models are typically applied when time series have unit roots and are co-integrated. Variables which are bounded to be between 0 and 1 should theoretically should not have unit roots in the long-run and should not be cointegrated. Especially, a variable which is bounded should not be integrated with an unbounded variable having a unit root. There cannot be a long run stable relationship if one variable increases or decreases continuously while the other is bounded. Therefore, the model, estimated in this paper, cannot be cointegrated in the very long-run. As I estimate this model for 26 years the long-run relationships show rather a medium-run view of the labor share. In the medium-run it could be possible to observe common movements of bounded variables. In order to account for this, I test for unit roots and cointegration in the model.

First I transform all variables such that the they are no longer bounded. An easy way to do so, is to transform variable x, such that

$$x=ln(x)-ln(a-x), \tag{14}$$

where a is the upper bound of the variable. The largest bounded variable is the capital-output ratio with an upper bound of 26. Therefore, I transform all variables with $a=26$. Under the transformation the variables are highly correlated with the untransformed variables.

Pooling all time series per variable and using panel data unit root test, the tests cannot reject unit root or reject the existence of unit-roots for all variables. I also test the variables by industries for unit roots using the Breitung panel data test for unit roots, which is powerful in for datasets of this size (Breitung, 2000; Breitung and Pesaran, 2005; Breitung and Das, 2005). For the globalization variables, the capital-output ratio and ICT-capital-output ratio the null of unit roots cannot be rejected. For the labor share for two thirds of the industries this hypothesis cannot be rejected. Therefore, I performed panel test for cointegration by Westerlund (Westerlund, 2007; Persyn and Westerlund, 2008). Although time series contain unit roots the H0 of no cointgration cannot be rejected in almost all circumstances. This holds for the full set of regressors as well as individual regressors and sets of regressors. Breitung and Pesaran (2005) discuss the complications with panel data and cointegration as well as unit roots. As a fraction of time series may have unit roots or may be cointegrated is not clear which fraction should be used as threshold to decide a system is cointegrated. Therefore. the estimation results in this paper show the short and long-run dynamics of the variables, but cannot necessarily be regarded as fixed relationships one would assume from co-integrated variables.

Appendix C. Descriptive Statistics

Variable	Abbreviation	Description	Data Source	availability
Labor Share	LS	total labor compensation over value added	EU KLEMS	industry level
Output	Y	real value added	EU KLEMS	industry level
Capital-Ouput Ratio	$\frac{K}{Y}$	real gross fixed capital stock over value added	EU KLEMS	industry level
ICT-Capital-Output Ratio	$\frac{K^{ICT}}{Y}$	ICT investments over value added	EU KLEMS	industry level
Openness	$open$	index of trade flows incl. (imports+exports)/GDP	KOF Index of Globalization	country level
Economic Restrictions	$rest$	trade and capital account restrictions	KOF Index of Globalization	country level
Union Coverage	$unioncov$	share of employees in workplaces cov. by ub, adjusted	ICTWSS Database 2009	country level
Unemployment Rate	u	ILO definition	ILO KILM	country level
Unemployment Benefits	$unben$	first year gross replacement rate	FRDB	country level
Wage Markup	$mark-up$	markup of local wage to average wage of interior market	EU KLEMS	industry level
Average Wage Interior Market	$instrument$	average wage of the industry in Europe w/o local market	EU KLEMS	industry level
Deflator		deflation of all nominal values with base year 2005	EU KLEMS	industry level
Exchange Rate		transferring all values to EURO	IMF	country level

Table C.1: Description of Relevant Variables.

Table C.2: Set of Countries Analyzed in this Study

Countries	times periods
Austria	1980 - 2005
Denmark	1980 - 2005
Finland	1980 - 2005
Germany	1991 - 2005
Italy	1980 - 2005
Netherlands	1980 - 2005
Portugal	1980 - 2005
Sweden	1993 - 2005
United Kingdom	1980 - 2005
Additional Countries for Robustness Check	
Australia	1982 - 2005
Czech Republic	1995 - 2005
Japan	1980 - 2005
United States	1980 - 2005

Table C.3: Set of Industries Analyzed in this Study

Industries
Food, Beverages and Tobacco / Textiles, Textile, Leather and Footwear / Wood and of Wood and Cork / Pulp, Paper, Printing and Publishing / Coke, refined petroleum and nuclear fuel / Chemicals and chemical / Rubber and plastics / Other Non-Metallic Mineral / Basic Metals and Fabricated Metal / Machinery; Nec. / Electrical and Optical Equipment / Transport Equipment / Manufacturing Nec.; Recycling / Electricity, Gas and Water Supply / Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel/ Wholesale trade and commission trade / Retail trade; repair of household goods / Transport and Storage / Post and Telecommunications / Financial Intermediation / Real Estate/ Renting of M+Eq. and Business Activities /
Additional Industries for Robustness Check
Agriculture, Hunting, Forestry, and Fishing / Mining and Quarrying / Construction / Hotels and Restaurants / Research and Development

Table C.4: Labor Share by Industry Subgroups

Variable	Obs	1980-2005 Mean	Min	Max	1985 Mean	2005 Mean
Agriculture	271	73.0	31.2	142.0	71.69	82.89
Mining and Quarrying	297	34.6	2.3	77.6	30.34	30.00
Manufacturing	4095	69.3	4.0	159.5	71.58	66.27
Electricity, Gas and Water Supply	323	32.8	17.2	98.6	35.71	26.52
Construction	297	81.6	53.7	103.8	83.03	78.96
Wholesale and Retail Trade	943	76.0	40.0	114.3	76.13	74.17
Services	2183	60.3	2.4	166.1	62.21	57.60

Source: EU KLEMS, Author's Calculations.

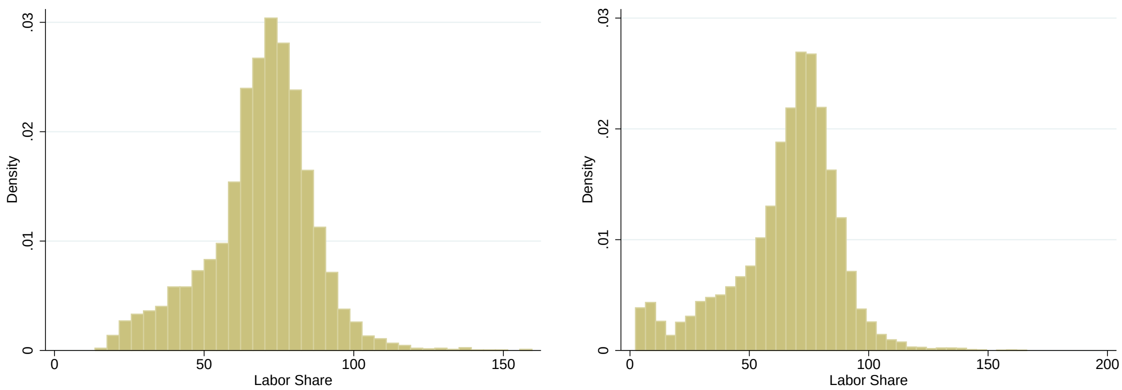

Figure 2: Histograms of the Labor Share; Main Dataset and Dataset for Robustness Estimation; source: EU KLEMS, Author's Calculations.

Table C.5: Descriptives on Industry Level

Variable	Obs	1980-2005 Mean	Min	Max	1985 Mean	2005 Mean
labor share	4836	69.08	13.53	159.54	70.21	65.90
k/y	4045	2.19	0.18	25.93	2.20	2.28
ict/y	4045	0.04	0.00	0.93	0.01	0.08
union coverage	4652	77.09	32.3	99	77.43	76.29
unempl. benefits	4862	47.36	0.5	87.25	48.11	49.36
unemployment rate	4403	7.14	1.6	16.4	7.80	6.95
restrictions	4862	85.86	67.65	97.11	51.37	79.65
openness	4862	61.19	23.45	95.43	79.73	89.30

Source: cf. Table C.1, Author's Calculations.

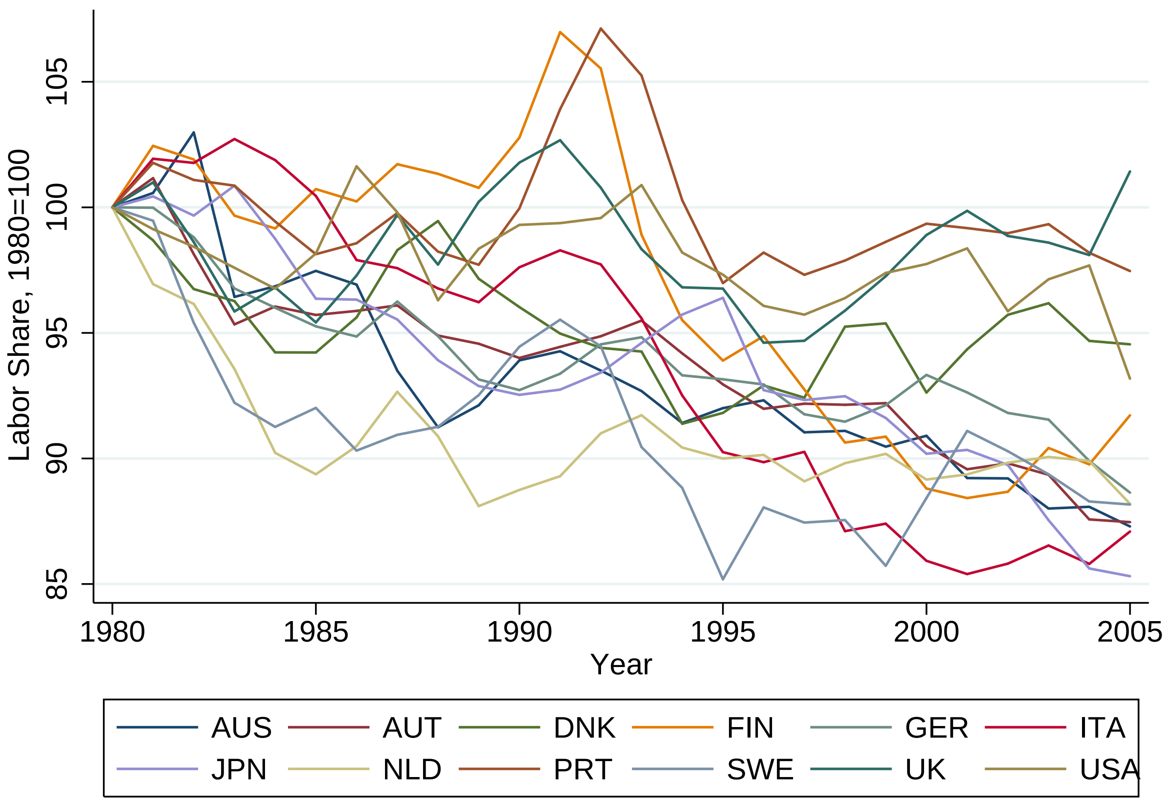

Figure 3: Labor Share Relative to its Value in 1980; Source: EU KLEMS, Author's Calculations.

Appendix D. Tables: Robustness Analysis

Table D.6: Results for Main Regression, by Skill Group, and by Sector (Large Sample)

Dependent Variables: First Difference of the Log Labor Share of the industry, the Respective Skill Group, or Sector of industry j in country i						
	Overall	High	Med. and Low	Low	Manufacturing	Services
$ln\ s^i_{L,t-1}$	-0.245***	-0.168***	-0.231***	-0.134***	-0.346***	-0.162***
	(0.038)	(0.038)	(0.036)	(0.047)	(0.055)	(0.024)
$ln\ (K/Y)_{t-1}$	0.047***	0.036**	0.053***	0.037***	0.049	0.052***
	(0.017)	(0.017)	(0.016)	(0.014)	(0.032)	(0.014)
$ln\ \left(K^{ICT}/Y\right)_{t-1}$	0.007	0.009	0.009	0.014	0.004	0.006
	(0.007)	(0.010)	(0.007)	(0.011)	(0.015)	(0.004)
$ln\ union_{t-1}$	0.030*	0.006	0.044***	0.100**	0.026	0.017
	(0.017)	(0.043)	(0.012)	(0.044)	(0.038)	(0.016)
$ln\ unben_{t-1}$	0.002	-0.007**	0.006**	-0.052***	0.012***	-0.007***
	(0.002)	(0.004)	(0.003)	(0.013)	(0.004)	(0.002)
$ln\ u_{t-1}$	0.005	-0.028*	-0.004	-0.010	0.011	-0.016***
	(0.009)	(0.015)	(0.006)	(0.012)	(0.018)	(0.006)
$ln\ rest_{t-1}$	-0.054	0.126	-0.018	0.017	-0.126	0.010
	(0.056)	(0.134)	(0.048)	(0.150)	(0.115)	(0.046)
$ln\ open_{t-1}$	-0.067***	-0.070**	-0.068***	0.007	-0.104***	-0.020
	(0.014)	(0.034)	(0.019)	(0.045)	(0.021)	(0.018)
$\Delta\ ln\ (K/Y)_t$	0.202**	0.210**	0.205**	0.214**	0.172*	0.375***
	(0.092)	(0.092)	(0.091)	(0.091)	(0.095)	(0.053)
$\Delta\ ln\ (K/Y)_{t-1}$	0.047	0.045	0.040	0.028	0.080	-0.052*
	(0.059)	(0.059)	(0.059)	(0.064)	(0.065)	(0.027)
$\Delta\ ln\ (K/Y)_{t-2}$	-0.019	-0.024	-0.026	-0.044	-0.010	-0.055
	(0.039)	(0.047)	(0.038)	(0.040)	(0.047)	(0.036)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_t$	-0.015***	-0.020***	-0.011**	-0.003	-0.028***	-0.004
	(0.005)	(0.008)	(0.005)	(0.008)	(0.008)	(0.005)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-1}$	-0.015	-0.018	-0.015	-0.009	-0.027*	0.001
	(0.009)	(0.011)	(0.010)	(0.008)	(0.015)	(0.007)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-2}$	-0.002	-0.002	-0.001	0.013*	-0.006	0.000
	(0.005)	(0.006)	(0.005)	(0.007)	(0.011)	(0.008)
$\Delta\ ln\ union_t$	0.105***	-0.156**	0.140***	0.182*	0.279***	-0.104*
	(0.040)	(0.072)	(0.040)	(0.102)	(0.075)	(0.061)
$\Delta\ ln\ union_{t-1}$	0.050	0.155	0.014	-0.035	0.040	0.137***
	(0.081)	(0.126)	(0.068)	(0.134)	(0.159)	(0.048)
$\Delta\ ln\ union_{t-2}$	0.013	-0.219***	0.011	0.177	0.060	-0.045
	(0.043)	(0.065)	(0.051)	(0.160)	(0.070)	(0.036)
$\Delta\ ln\ unben_t$	0.004	0.013*	0.007***	-0.018*	0.012**	-0.012***
	(0.003)	(0.007)	(0.003)	(0.010)	(0.006)	(0.004)
$\Delta\ ln\ unben_{t-1}$	0.008**	0.015**	0.007*	0.028***	0.004	0.016***
	(0.003)	(0.007)	(0.004)	(0.007)	(0.005)	(0.003)
$\Delta\ ln\ unben_{t-2}$	-0.003	0.010	-0.002	0.017	-0.013	0.002
	(0.008)	(0.009)	(0.007)	(0.011)	(0.016)	(0.003)

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Table D.6 – *continued from previous page*

	Overall	High	Med. and Low	Low	Manufacturing	Services
$\Delta\ ln\ u_t$	-0.003	0.008	-0.013	-0.032	0.003	-0.034***
	(0.018)	(0.033)	(0.016)	(0.042)	(0.030)	(0.011)
$\Delta\ ln\ u_{t-1}$	-0.045***	0.001	-0.042**	-0.028	-0.062**	-0.015
	(0.017)	(0.042)	(0.017)	(0.019)	(0.026)	(0.012)
$\Delta\ ln\ u_{t-2}$	-0.007	0.009	-0.002	-0.005	-0.012	0.006
	(0.013)	(0.036)	(0.012)	(0.021)	(0.024)	(0.008)
$\Delta\ ln\ rest_t$	-0.162**	-0.085	-0.162**	-0.277**	-0.273*	0.065
	(0.070)	(0.159)	(0.067)	(0.140)	(0.144)	(0.054)
$\Delta\ ln\ rest_{t-1}$	-0.018	-0.188	-0.038	-0.034	0.005	-0.064
	(0.053)	(0.125)	(0.062)	(0.134)	(0.107)	(0.066)
$\Delta\ ln\ rest_{t-2}$	-0.041	-0.037	-0.036	0.225	0.011	0.016
	(0.087)	(0.161)	(0.074)	(0.205)	(0.076)	(0.080)
$\Delta\ ln\ open_t$	-0.066***	-0.062	-0.068***	-0.052	-0.088**	-0.024
	(0.020)	(0.040)	(0.022)	(0.040)	(0.035)	(0.019)
$\Delta\ ln\ open_{t-1}$	-0.023	-0.033	-0.017	-0.039	-0.016	-0.028
	(0.021)	(0.041)	(0.022)	(0.053)	(0.024)	(0.021)
$\Delta\ ln\ open_{t-2}$	0.027**	0.042	0.031**	0.041	0.027	0.014
	(0.011)	(0.036)	(0.012)	(0.035)	(0.020)	(0.013)
cons	0.183	0.772	2.124***	0.856	0.668	0.044
	(0.215)	(0.554)	(0.435)	(0.688)	(0.444)	(0.180)
$time - trend$	✓	✓	✓	✓	✓	✓
$time - trend^2$	✓	✓	✓	✓	✓	✓
N	5865	5865	5865	5865	2968	2032
r2	0.208	0.155	0.202	0.192	0.242	0.261

Cluster robust standard errors in parentheses with two-way clustering on country and industry-country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D.7: Pre and Post 94

Dependent Variable: First Difference of the Log Labor Share Estimation with Small Sample for Europe						
	Small Sample		Manufacturing		Services	
	1980-1993	1994-2005	1980-1993	1994-2005	1980-1993	1994-2005
$ln\ s_{L,t-1}$	-0.319***	-0.290***	-0.347***	-0.317***	-0.249***	-0.241***
	(0.040)	(0.052)	(0.048)	(0.064)	(0.017)	(0.020)
$ln\ (K/Y)_{t-1}$	0.059**	0.048	0.064**	0.040	0.068***	0.072***
	(0.029)	(0.030)	(0.030)	(0.042)	(0.019)	(0.020)
$ln\ \left(K^{ICT}/Y\right)_{t-1}$	*0.005*	*-0.007*	*-0.001*	*-0.016*	0.016***	0.009*
	(0.007)	*(0.009)*	*(0.008)*	*(0.014)*	(0.002)	(0.005)
$ln\ union_{t-1}$	*0.106***	*0.043**	*0.167****	*0.035*	*0.009*	*0.054**
	(0.050)	*(0.025)*	*(0.062)*	*(0.029)*	*(0.041)*	*(0.029)*
$ln\ unben_{t-1}$	0.003	-0.009**	0.005	0.002	-0.004	-0.018**
	(0.006)	(0.005)	(0.008)	(0.006)	(0.005)	(0.007)
$ln\ u_{t-1}$	0.007	0.006	0.004	0.006	0.005	0.005
	(0.017)	(0.016)	(0.024)	(0.026)	(0.013)	(0.010)
$ln\ rest_{t-1}$	-0.018	0.021	0.007	0.115	-0.081	-0.127
	(0.109)	(0.060)	(0.163)	(0.091)	(0.119)	(0.106)
$ln\ open_{t-1}$	-0.091	-0.068***	-0.073	-0.065**	-0.091***	-0.084*
	(0.056)	(0.024)	(0.080)	(0.028)	(0.034)	(0.047)
$\Delta\ ln\ (K/Y)_t$	*0.370****	*0.324****	*0.402****	*0.308****	0.402***	0.412***
	(0.105)	*(0.107)*	*(0.105)*	*(0.119)*	(0.037)	(0.042)
$\Delta\ ln\ (K/Y)_{t-1}$	*0.117**	*0.142***	*0.139***	*0.171****	-0.011	-0.004
	(0.060)	*(0.065)*	*(0.062)*	*(0.062)*	(0.031)	(0.030)
$\Delta\ ln\ (K/Y)_{t-2}$	*-0.030*	*-0.005*	*-0.039*	*0.002*	-0.009	-0.004
	(0.053)	*(0.058)*	*(0.058)*	*(0.073)*	(0.039)	(0.034)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_t$	*-0.005*	*-0.016***	*-0.007*	*-0.020***	*-0.005*	*-0.012***
	(0.011)	*(0.008)*	*(0.015)*	*(0.009)*	*(0.007)*	*(0.006)*
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-1}$	-0.014**	-0.000	*-0.026****	*0.001*	0.005	0.006
	(0.006)	(0.009)	*(0.007)*	*(0.014)*	(0.011)	(0.010)
$\Delta\ ln\ \left(K^{ICT}/Y\right)_{t-2}$	*0.004*	*0.014**	*0.005*	*0.022***	-0.012	-0.013
	(0.006)	*(0.008)*	*(0.009)*	*(0.011)*	(0.012)	(0.010)
$\Delta\ ln\ union_t$	0.019	0.042	-0.013	0.023	0.004	0.014
	(0.070)	(0.058)	(0.115)	(0.097)	(0.097)	(0.084)
$\Delta\ ln\ union_{t-1}$	*0.025*	*0.062*	*-0.122*	*-0.029*	0.285***	0.242***
	(0.133)	*(0.118)*	*(0.189)*	*(0.168)*	(0.084)	(0.057)
$\Delta\ ln\ union_{t-2}$	*-0.086*	*-0.028*	*-0.107*	*-0.017*	-0.013	-0.017
	(0.054)	*(0.051)*	*(0.069)*	*(0.065)*	(0.056)	(0.057)
$\Delta\ ln\ unben_t$	*0.003*	*-0.012*	0.014***	0.000	-0.014**	-0.027*
	(0.005)	*(0.010)*	(0.005)	(0.009)	(0.006)	(0.014)
$\Delta\ ln\ unben_{t-1}$	0.005	0.029***	0.002	0.025**	*0.014****	*0.026****
	(0.005)	(0.007)	(0.006)	(0.011)	*(0.004)*	*(0.006)*
$\Delta\ ln\ unben_{t-2}$	-0.005	0.005	-0.005	0.002	-0.004	0.004
	(0.009)	(0.009)	(0.011)	(0.013)	(0.006)	(0.006)

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Table D.7 – *continued from previous page*

	Small Sample		Manufacturing		Services	
	1980-1993	1994-2005	1980-1993	1994-2005	1980-1993	1994-2005
$\Delta\ ln\ u_t$	-0.008	-0.014	0.002	-0.009	-0.026*	-0.029
	(0.021)	(0.020)	(0.033)	(0.026)	(0.015)	(0.020)
$\Delta\ ln\ u_{t-1}$	-0.030*	-0.020	-0.026	-0.014	-0.024**	-0.026***
	(0.017)	(0.018)	(0.023)	(0.024)	(0.011)	(0.010)
$\Delta\ ln\ u_{t-2}$	-0.012	0.003	-0.008	0.008	-0.019	-0.015
	(0.023)	(0.015)	(0.032)	(0.023)	(0.015)	(0.016)
$\Delta\ ln\ rest_t$	-0.081	-0.137*	-0.120	-0.169	0.006	-0.026
	(0.085)	(0.077)	(0.127)	(0.116)	(0.079)	(0.067)
$\Delta\ ln\ rest_{t-1}$	-0.096*	-0.149***	-0.158**	-0.239***	0.023	0.029
	(0.056)	(0.042)	(0.076)	(0.047)	(0.078)	(0.088)
$\Delta\ ln\ rest_{t-2}$	*-0.071*	*-0.129*	*-0.162*	*-0.239**	0.133	0.116
	(0.103)	*(0.111)*	*(0.142)*	*(0.145)*	(0.087)	(0.096)
$\Delta\ ln\ open_t$	-0.083**	-0.039	-0.078*	-0.048	-0.068	-0.041
	(0.037)	(0.025)	(0.045)	(0.036)	(0.052)	(0.036)
$\Delta\ ln\ open_{t-1}$	0.054	0.059*	0.058	0.050	*0.040*	*0.070****
	(0.052)	(0.032)	(0.077)	(0.049)	*(0.026)*	*(0.020)*
$\Delta\ ln\ open_{t-2}$	0.037*	0.031	0.032	0.021	0.031	0.044
	(0.021)	(0.033)	(0.035)	(0.047)	(0.023)	(0.035)
cons		-0.231		-0.743		0.719
		(0.356)		(0.525)		(0.446)
$time - trend$		✓		✓		✓
$time - trend^2$		✓		✓		✓
N		3259		2160		1099
r2		0.315		0.332		0.344

Results in italics indicate a significant difference between the two periods on the 10 percent level. Cluster robust standard errors in parentheses with two-way clustering on country and industry-country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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