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Globalization, creative destruction, and labour share change: evidence on the determinants and mechanisms from longitudinal plant-level data

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The labour share of GDP has declined in recent decades in many leading economies. This paper examines the mechanisms of falling labour share using Finnish manufacturing plant-level data over three decades. Using a useful variant of the decomposition method, we make a distinction between the changes in the average plant and the micro-level restructuring. We show that micro-level restructuring is the link between the declining labour share and increasing productivity, and that increased international trade is a factor underlying those shifts.

JEL classifications: F16, J31.

1. Introduction

The labour share of value added was regarded as 'a magic constant' (Solow, 1958). The constancy of the labour share was also treated as one of the stylized facts of economic growth (e.g., Gollin, 2002). The motivating empirical fact for this paper is that, in contrast to this, there are several industrialized countries in which the labour share has declined substantially over the past few decades (e.g., Blanchard, 1997). Secular decline in the labour share since the early 1980s has been much more pronounced in Europe and Japan (roughly 10 percentage points) than in Anglo-Saxon countries, including the United States (about 3–4 percentage points) (IMF, 2007). Within Europe, the strongest decline in the labour share has been experienced in Austria, Finland, Ireland, and the Netherlands. It is important to know how these changes emerge: Do the labour shares start to decline because of accelerated productivity or decelerated wage growth and, in particular, what are the micro-level mechanisms underlying those changes?

Modern growth theories emphasize the role of intra-industry micro-level restructuring as one of the key mechanisms for explaining industry productivity growth (e.g., Aghion and Howitt, 2006). Research in the field of international trade has also indicated that globalization is an important stimulant of productivity-enhancing micro-restructuring (creative destruction) within industries (e.g., Bernard *et al.*, 2007; Lileeva, 2008). In particular, Bernard and Jensen (2004) show that exporting does not increase plant productivity growth but has positive aggregate productivity effects because it is associated with the reallocation of resources from less efficient to more efficient plants.

We contribute to the literature by distinguishing between two intrinsically different micro-level mechanisms underlying the industry labour share changes: (i) the labour share change of the average plant, and (ii) the micro-structural change. Furthermore, we both formally and empirically link the micro-level dynamics of the labour share change, productivity growth and wage growth. These links emerge due to the fact that industry productivity and wage growth together determine the change in the labour share. In this paper, we apply this novel approach to analyse the potential contribution of globalization on the decline in the labour share.[1] In particular, we examine whether increased competition owing to the exposure to international trade and foreign ownership forces the plants with the highest share of labour income to decrease their market shares and whether it eventually forces them out of business. This central hypothesis of the paper is closely related to modern theoretical insights. Melitz (2003) argues that an increase in an industry's exposure to international trade will lead to inter-firm reallocations towards more productive firms by increasing competitive pressures.

The link between the labour share and globalization is not well understood. Existing evidence about the effects of globalization on the labour share is based on cross-country studies (Harrison, 2002; Guscina, 2006; Jaumotte and Tytell, 2007; Jayadev, 2007; Decreuse and Maarek, 2008; European Commission, 2008). The main problem with cross-country studies is that there are a large number of contributing factors across countries that are identified with a relatively small number of observations, i.e. the curse of dimensionality plagues the cross-country approach. Cross-country regressions are therefore likely to suffer from omitted variable and parameter heterogeneity biases. The differences in the data characteristics make it hard to conduct a reliable comparison of the plant-level dynamics of the labour share across countries. This makes it particularly useful to provide a detailed analysis of one country. To examine the effects of globalization, we construct a panel of industries and regions from the micro-level components of

[1] Ripatti and Vilmunen (2001), Sauramo (2004), and Kyyrä and Maliranta (2008) provide evidence on the development of the labour share in Finland.

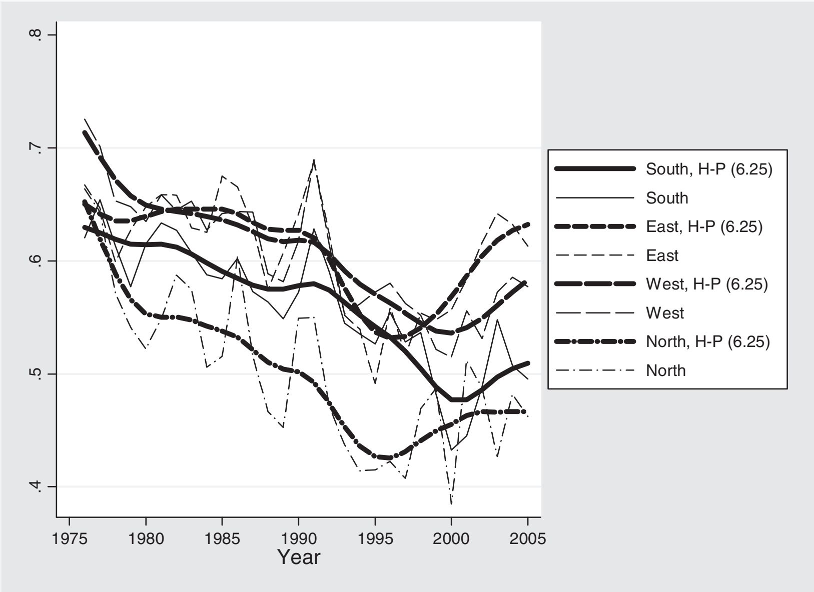

Fig. 1 The labour share by region

Note: The labour shares are smoothed by using the Hodrick-Prescott filter with a parameter value of 6.25, as proposed by Ravn and Uhlig (2002). Thin lines indicate the unfiltered series.

the labour share. While using the same plant-level data in the analysis of industries and regions within the same country, data comparability problems can be bypassed.

The role of labour market regulations and other institutional aspects has gained considerable attention in the cross-country comparisons of the labour share dynamics (Bentolila and Saint-Paul, 2003; Azmat *et al.*, 2007; IMF, 2007). In contrast to this research, we build on the fact that there are large differences in the micro-level dynamics of the labour share across regions within the same country that share exactly the same institutions and regulations. Hence, the focus on one country allows us to isolate the effects of globalization on the labour share more clearly, because we are able to avoid, by construction, the problems that emerge from the complex interactions between a variety of labour market institutions and openness that Rodrik (1997) and Agell (1999) have pointed out.

The Finnish case provides an excellent opportunity to analyse the effects of globalization, because the openness of the economy has greatly increased during the past few decades. At the same time, there has been a considerable decline in the labour share. Figure 1 exhibits the downward trends in the manufacturing sector in four Finnish regions.[2] Plenty of variation in the trends across regions provides us

[2] More recently there has been some increase in the labour share in all regions. The timing of this increase differs across regions. The unfiltered series also reveal that there are a lot of short-run changes in the labour share.

with an interesting opportunity to identify the mechanisms underlying these changes.

The structure of the paper is as follows. Section 2 introduces the decomposition method. Section 3 describes the longitudinal plant-level data. Section 4 relates the micro-level components to the changes in international trade and foreign ownership. The last section concludes.

2. Decomposition of the labour share into its micro-level components

The starting point of our analysis is the fact that the industry (or aggregate) labour share declines when industry labour productivity growth exceeds industry wage growth (measured in product prices). The existing studies in the literature assume that these industry or more aggregate level changes represent changes in a representative firm, and, as a consequence, the role of the micro-level restructuring is ignored. Our approach allows a coherent tracking of the roles of the micro-level dynamics of productivity and wage growth.

The literature provides several different methods to decompose aggregate productivity growth (see Bartelsmans and Doms, 2000; Foster *et al.*, 2001; Kruger, 2008). We adopt a formula that has several useful properties that make the interpretation of the components easy in this context. Our method has some important resemblances to those proposed by Maliranta (1997), Vainiomäki (1999) and, more recently, by Diewert and Fox (2009). The within component is defined as the weighted average of the changes in the labour shares of the continuing plants. The between component is negative when there is a systematic structural change among continuing plants in terms of value added towards those plants that have a lower labour share. It is also possible to separate the entry and exit components. The total effect of entries and exits is the difference between the total aggregate change in the labour share and the aggregate change in the labour share among the continuing units.

We denote the labour share of a production plant i in period t with $f_{it} = w_{it}/v_{it}$, where w_{it} is the wage sum (including social security payments) and v_{it} is value added. Both of them are measured in product prices (i.e. deflated by a price index of the industry).[3] We decompose the change rate of the aggregate labour share from period $t-1$ to period t. Plants appearing in periods $t-1$ and t are classified into three groups: those appearing in both $t-1$ and t, i.e. continuing plants, are indicated by C, those appearing in t but not in $t-1$, i.e. entrants, are indicated by E, and those appearing in $t-1$ but not in t, i.e. disappearing plants, are indicated by D.

[3] To be more precise, we use a chain-index procedure. Value added and wages in year t are expressed in year t-1 prices.

The aggregate labour share change rate consists of two distinct main components. These are the change rate within units and the effect of micro-structural change that is the structural component (denoted by STR_t^F):[4]

$$\frac{F_t - F_{t-1}}{\bar{F}} = \sum_{i \in C} \bar{s}_i \frac{f_{it} - f_{i,t-1}}{\bar{f}_i} + STR_t^F \tag{1}$$

where $F_t = \sum_i w_{it} / \sum_i v_{it}$ is the aggregate labour share in period t; $\bar{F} = 0.5(F_{t-1} + F_t)$ is the average aggregate labour share in periods $t-1$ and t; $\bar{f}_i = 0.5(f_{i,t-1} + f_{it})$ is the average labour share of plant i in periods $t-1$ and t, and $s_{it} = v_{it} / \sum_{j \in C} v_{jt}$ is the weight of unit i as measured by its share of aggregate value added among continuing units.

It should be noted that

$$\frac{F_t - F_{t-1}}{\bar{F}} \cong \log \frac{F_t}{F_{t-1}} \tag{2}$$

and

$$\frac{f_{it} - f_{i,t-1}}{\bar{f}_i} \cong \log \frac{f_{it}}{f_{i,t-1}}. \tag{3}$$

Consequently, here the within component is similar to a Divisia index of the growth rate of the total factor productivity but now applied to the continuing plants (where the change rate is relevant) and used for the estimation of the growth rate of the labour share. It describes the change rate of the labour share in a representative plant.

The structural component consists of four sub-components

$$\begin{aligned} STR_t^F = {} & S_t^E \frac{\left(F_t^E - F_t^C\right)}{\bar{F}} - S_{t-1}^D \frac{\left(F_{t-1}^D - F_{t-1}^C\right)}{\bar{F}} + \sum_{i \in C} \frac{\bar{f}_i}{\bar{F}} \left(s_{it} - s_{i,t-1}\right) \\ & + \sum_{i \in C} \bar{s}_i \frac{f_{it} - f_{i,t-1}}{\bar{f}_i} \left(\frac{\bar{f}_i - \bar{F}}{\bar{F}}\right) \end{aligned} \tag{4}$$

where $F^X = \sum_{i \in X} w_i / \sum_{i \in X} v_i$ is the aggregate labour share among the group $X \in \{E,C,D\}$, and $S^X = \sum_{i \in X} v_i / \sum_i v_i$ is the value added share of the group $X \in \{E,C,D\}$, and $\bar{s}_i$ is the average of s_{t-1} and s_t.

The direct contribution of the entering plants to the aggregate growth rate of the labour share is gauged by the first component of eq. (4). It is positive when the average labour share of the new plants (weighted by the value added share) in the period t is higher than that of those who appeared in the period $t-1$. The magnitude of the contribution is dependent on the value added share of the new plants in the period t.

[4] Derivation of eqs (1) and (4) is presented in Appendix 1.

The second component, the exit component, is analogous to the entry component. Therefore, one of the great advantages of this decomposition method is that entries and exits are treated symmetrically. The exit component is negative when the average labour share of the disappearing plants (weighted by the value added share) is higher than that of those plants that appear also in the next period t. The magnitude of the contribution is dependent on the value added share of the disappearing plants before they leave, i.e. in the period $t-1$ (see also Maliranta, 1997, 2003; Diewert and Fox, 2009).

The third component is the between component, which captures the effect of the value added share changes among the continuing plants on the aggregate labour share change rate. This component is negative when the low labour share plants (i.e. high profitability plants) increase their market shares at the cost of the high labour share plants (i.e. low profitability plants). The between component, like the within component, is defined among the continuing plants only. As a result, entering or disappearing plants do not have any direct effect on those components. The fourth component on the right-hand side of eq. (4) can be called the cross-component.

Equations (1) and (4) can be applied to industry productivity and wage growth. When industry labour productivity and industry wage growth are measured in nominal terms or when both are deflated by the same price index (as in our paper), the following relationship holds at the industry (or aggregate) level:

$$\frac{F_t - F_{t-1}}{\bar{F}} \approx \frac{W_t - W_{t-1}}{\bar{W}} - \frac{P_t - P_{t-1}}{\bar{P}}$$
$$\Leftrightarrow \sum_{i\in C} \bar{s}_i \frac{f_{it} - f_{i,t-1}}{\bar{f}_i} + STR_t^F \approx \sum_{i\in C} \bar{s}_i^* \frac{w_{it} - w_{i,t-1}}{\bar{w}_i} + STR_t^W - \sum_{i\in C} \bar{s}_i^* \frac{p_{it} - p_{i,t-1}}{\bar{p}_i} - STR_t^P \tag{5}$$

where $\bar{s}_i^* = 0.5\left(l_{i,t-1}/\sum_{j\in C} l_{j,t-1} + l_{it}/\sum_{j\in C} l_{jt}\right)$, and l_i, f_i, w_i, and p_i denote the labour input (hours), labour share, wages, and social security payment per labour input, and value added per labour input in a plant i (i.e. plant labour productivity), respectively. W is the aggregate wages and social security payments per labour input, P is the aggregate value added per labour input (i.e. aggregate labour productivity), and STR_t^W and STR_t^P are the structural components of industry wage and industry productivity growth, respectively.

Naturally, an analogous relationship holds at the plant level

$$\frac{f_{it} - f_{i,t-1}}{\bar{f}_i} \approx \frac{w_{it} - w_{i,t-1}}{\bar{w}_i} - \frac{p_{it} - p_{i,t-1}}{\bar{p}_i} \tag{6}$$

and therefore we have

$$\sum_{i\in C} \bar{s}_i \frac{f_{it} - f_{i,t-1}}{\bar{f}_i} \approx \sum_{i\in C} \bar{s}_i^* \frac{w_{it} - w_{i,t-1}}{\bar{w}_i} - \sum_{i\in C} \bar{s}_i^* \frac{p_{it} - p_{i,t-1}}{\bar{p}_i} \tag{7}$$

Table 1 Conceptual framework and empirical decomposition of the changes in the labour share, annual weighted averages for the period 1975–2007

Industry-level aggregates		Micro-level mechanisms	
		Change in the average plant	Plant-level restructuring
Panel A: conceptual framework			
Wage change (= a + b)	dW	a	b
Labour productivity change (= c + d)	dP	c	d
The labour share change (= (dW—dP) = (a+b)—(c + d) = (a − c) + (b − d))	dF		
Panel B: empirical decomposition			
Wage change = dW	3.7%	3.7%	0.0%
Labour productivity change = dP	4.2%	3.3%	1.0%
The labour share change = dF = (dW—dP)	−0.5%		

Notes: Averages are computed by using the value added share weights. Figures may not add up due to rounding.

By inserting (7) into (5) we obtain

$$STR_t^F \approx STR_t^W - STR_t^P \tag{8}$$

which shows how the structural components of the labour share change, wage growth, and productivity growth are related to each other.

Panel A of Table 1 illustrates our approach to track the changes in the labour share. The earlier literature has focused only on some specific aspects of these changes. There are various popular ways to decompose the industry-level aggregate productivity growth (see Foster *et al.*, 2001). However, existing studies have not provided decompositions of wage growth (dW), which is the other important aggregate determinant of the observed changes in the labour share. In this paper, we provide a complete and coherent picture of the micro-level mechanisms ($a, \ldots, d$) that are behind the aggregate movements in the labour share (dF).

Analysis of the micro-level components of the labour share is particularly useful in the Finnish context, because the wage bargaining system adopted in Finland has distinct implications on the evolution of the micro-level components. The coverage of collective agreements is 95% of all employees in Finland, one of the highest rates among the OECD countries (Layard and Nickell, 1999). The Finnish 'wage increase formula' defines the scope for nominal wage cost increases as the sum of the core inflation target (2% *per annum*) and the average increase in productivity across the whole economy. Nominal wages are therefore not encouraged to adjust to the changes in labour productivity that are considered to be isolated to certain sectors or regions. Specifically, wage increases have not been tied to plant-level (real or nominal) productivity advances.

Because of the attributes of the Finnish wage bargaining system, our expectation is that wage growth takes place mainly through the within plant component and therefore intra-industry restructuring is not a significant source of industry wage growth. If industry productivity growth equals industry wage growth (i.e. the aggregate labour share is stable) and industry productivity growth exceeds plant productivity growth, the within component of the labour share change has a positive contribution and the restructuring component has the opposite (negative) contribution. This paper looks at how globalization drives wedges between these balances.

Panel B of Table 1 provides an empirical description of the micro-level channels of the industry labour share change in Finnish manufacturing in the period 1976–2007, based on the longitudinal plant-level data. It shows the break-down of the industry labour share change into the contributions of productivity and wage growth, and what the micro-level components of productivity and wage growth are. The industry labour share has declined 0.5% *per annum* because the labour productivity growth rate (4.2%) has exceeded that of wages (3.7%, measured in product prices) by a margin of 0.5 percentage points. At the 'average plant', however, the development has been quite different as can be seen from the table; wage growth has exceeded productivity growth by a margin of 0.5 percentage points. The last column of Panel B reveals the ultimate source of the labour share decline; the micro-level restructuring has been an essential ingredient of labour productivity but not of wage growth. The decomposition points out that industry productivity can exceed plant productivity growth when the high productivity plants grow faster in size than the low productivity units.

3. Data

The micro-structural components of the labour share are calculated by the use of longitudinal plant-level panel data that has been constructed especially for economic research purposes by the Research Laboratory of Statistics Finland (see Maliranta, 2003). The data are based on the Annual Industrial Statistics Surveys that basically cover all manufacturing plants employing at least five persons up to 1994. Since 1995 it has included all the plants owned by firms that have no fewer than 20 persons. Maliranta (2003) has examined in detail how sensitive the patterns of productivity components are to the change in the cut-off limit from five to 20 in the period 1975–94. The result was that the cut-off limit made little difference. This is because larger plants account for a substantial share of the total input usage. Still, to make our decompositions as comparable as possible over all the years we have harmonized the coverage of our data. We have included all the plants that have at least five persons and are owned by a firm that has no fewer than 20 persons.

The data are exceptionally good when it comes to the coverage, the content and the length of time series. However, as always with these kinds of data, our data are not perfect, either. Plant-level data always include outliers that are influential in the decompositions of aggregate changes. Thus, some method is needed to clean the data. To avoid distorting results by arbitrary editing we have applied a transparent procedure. We have adopted an approach similar to that of Mairesse and Kremp (1993). Those observations are deemed to be outliers whose log of the labour share differs by more than 4.4 standard deviations from the input-weighted industry average in that year. We have performed the decomposition computations for each pair of the consecutive years. If a plant is classified as an outlier in either an initial (i.e. in year $t-1$) or an end year (i.e. in year t) it is not included in this computation (but is possibly included in earlier and later periods). This way we have avoided causing artificial entries or exits by removing outliers. In the course of our analysis we noted that a single plant might sometimes have an impact on one of the components of our interest that is simply unbelievable. A more detailed inspection of these cases revealed that the changes in value added or labour input are sometimes erroneous beyond reasonable doubt. Since, on certain occasions, these errors are very influential in our decomposition calculations, further cleaning may be worthwhile. For this reason, the decompositions are made in two rounds. If the absolute value of the contribution of a single plant to one of the components is greater than four percentage points, the plant is classified as an outlier in the first round. This is a conservative criterion since, as we will see below, usually the size of these components is less than four percentage points at the level of industry and region. These outliers, accounting for 9.6% of the total hours in the whole period, are removed in the second round, which generates the final decomposition results.

To examine the effects of globalization, we have computed the micro-level components of the labour share change rate, productivity growth rate and wage growth rate for 12 industries and four regions over the period 1976–2007. Our industry classification is close to the two-digit standard industry classification, but we have combined some industries. The industries are the following: Food (NACE 15–6), Textile (17–9), Wood (20), Paper (21), Printing (22), Chemicals (23–5), Minerals (26), Metal products (27–8), Machinery (29 and 34–5), Electrical equipment (30–1), Communications equipment (32–3), and Other (36–7). This classification is dictated by our need for a reliable measurement of the decompositions of the labour shares by industries and regions.[5]

Finland is divided into five provinces (the so-called NUTS2 level in the European Union). However, we exclude the province of Åland, because the small number of plants in this island community means that the measures of the micro-level

[5] The assignment of plants to industries is not particularly problematic for two reasons. First, a plant is defined in the Annual Industrial Statistics Survey as a local kind-of-activity unit. It is a specific physical location, which is specialized in the production of certain types of products or services. Second, we use a relatively aggregated industry classification.

components of the labour shares would not be reliable. The use of these classifications gives us a panel data that has $4 \times 12 = 48$ observations per year. Since the components can be calculated for 31 pairs of years (1975–6, 1976–7, . . . , 2006–7), in principal we have 1488 observations. Since we use lagged explanatory variables, the number of observations is slightly smaller in our econometric analysis, however.

Productivity and wage growth rates are computed by using the industry-specific deflators that are implicit price indexes of output obtained from the Finnish National Accounts. We have used a 'chain-index' procedure. For each pair of the consecutive years, value added (and wages plus social security payments) of the end year (i.e. t) is deflated into the price level of the initial year (i.e. $t-1$) by the price index. The use of price indexes is not necessary in the analysis. (We obtained similar results with nominal measures.) The main point here is that we use the same deflators for both productivity and wage growth (or no deflators at all) to obtain consistent results for productivity, wage, and labour share change (see Feldstein, 2008).

Globalization is measured by two variables, which capture the exposure to international trade and foreign ownership.[6] The exposure to international trade is measured by dividing exports by the gross output. This is the measure that has been most frequently used in the literature to describe the effects of globalization on the labour share. For example, it has been used by Harrison (2002) and Guscina (2006), among others. The share of foreign-owned plants in an industry and a region is defined on the basis of output share. A 50% threshold is used in classifying a particular plant as foreign owned.

4. Results

Descriptive evidence reveals that there have been considerable differences in the micro-level dynamics of the labour share across regions within the same country that have shared exactly the same institutions and regulations.[7] The variation has been neglected in the literature. It can be exploited when we estimate the effect of globalization on the labour share change.

We use Prais-Winsten regressions with panel-corrected standard errors as the baseline reduced-form specifications for the period 1978–2007.[8] The estimator is based on the principle of estimating the amount of autocorrelation and then re-weighting the standards errors to correct them. Therefore, it is a weighted least squares estimator. The estimator is preferable in terms of efficiency to OLS

[6] Helpman *et al.* (2004) stress that multinational firms have the highest productivity. Therefore, they could be especially important in productivity dynamics as well. We do not have this information for a period long enough. Because we take advantage of a panel of industries and regions, we are not able to incorporate import penetration into the models, because there is no reliable information on import penetration both at the industry and regional level. One problem with the inclusion of imports would be the possible positive correlation between the changes in imports and exports.

[7] Appendix 2 reports descriptive statistics.

[8] Prais and Winsten (1954) present the idea of the estimation method.

in our context, because we have a considerable number of repeated observations on fixed units (industry × regions) with a potential first-order serial correlation. We assume that the structure of the AR (1) process is similar in each panel of the data, as recommended by Beck and Katz (1995). A further advantage of Prais-Winsten regressions is that we are able to incorporate cross-sectional correlation to the model when the number of time-series observations is less than the number of cross-sectional observations, whereas standard feasible generalized least squares cannot (Chen *et al.,* 2006). The sample consists of 1440 observations (four regions, 12 industries, and 30 years).

If the focus were the within plant changes, we would use those approximately 150,000 plant-level observations that are available in the original panel data. However, in this paper the main interest is to look at the role of plant-level restructuring. The industry-region panel constructed by the decomposition computations is a useful way to capture it. The aim is to identify an additional role of the exposure to globalization, i.e. to study whether there is evidence of a structural change in terms of valued added towards those plants that have a lower labour share because of globalization. With the data and the methods applied here we can consistently analyse the role of plant-level changes (i.e. within plant changes) and micro-structural components in industry development.

We estimate specifications with the following structure:

$$Y_{kit} = \alpha_{ki} + \eta GLOBALIZATION_{kit} + \varepsilon_{kit} \tag{9}$$

The dependent variables (Y_{kit}) of the models are the industry growth rates of the labour share, labour productivity and wage, and their micro-level components for industry k in region i in year t. The explanatory variables are the measures of globalization along with the control variables. The control variables include a full set of the unreported fixed industry-region effects (α_{ki}). Prais-Winsten regressions do not contain separate year effects. However, it is assumed that disturbances may be heteroscedastic and contemporaneously correlated across panels (i.e. industry × regions).

The variables that capture the changes in the exposure to international trade and foreign ownership are included in the models as lagged up to two years. There are two reasons for this. First, and most importantly, it should take some time before the effects on the labour share change appear. In particular, Maliranta (2005) shows that it is worthwhile taking into account the lagged effects when examining the influences of international trade on restructuring. Second, the contemporary correlation between the exposure to international trade and the labour share change could be the reverse, because a decline in the labour share improves the competitiveness of domestic production that tends to increase export volume in a small open economy.

The lagged effect is arguably closer to the causal effect. That being said, we cannot directly address the possibility that the measures of globalization may be endogenous, because our data do not contain appropriate economic instruments for globalization that could be claimed to be truly independent of the micro-level components of the labour share change.[9] Thus, we essentially document correlations between globalization and different micro-level components of the labour share change. The problems regarding the causal interpretation of the estimates are even more apparent in the existing cross-county studies. One advantage of our approach is that the labour market regulations and other institutional aspects are similar for all units of observation (industry × region) in the estimations, because we focus on one country. This reduces the omitted variable bias. We are also able to test the strict exogeneity of the regressors by including the lead values of the measures of globalization among the explanatory variables. We acknowledge that this approach is far from being ideal to fully establish causality. Despite this shortcoming, we regard our contribution as being a first systematic account of the relationship between globalization and the micro-level mechanisms of the changes in the labour share of value added.

All models are estimated by taking advantage of unfiltered data. The use of filtered data to estimate models is not an appropriate strategy for two reasons. First, the Hodrick-Prescott filter smoothes the data and leads to a complicated pattern of autocorrelation with future and past components in the dependent variables. This most likely would lead to spurious regression results (Meyer and Winker, 2005). Second, the pre-filtering of the dependent variables would mean that they were measured with an error. This generates a systematic pattern of heteroskedasticity (Saxonhouse, 1977). It would be very difficult to construct an econometric model to tackle both of these problems.

The baseline estimates that consist of nine models are reported in Table 2. The first column shows that increasing exports lowers the industry labour share. The negative effect of the industry labour share comes from both the within component (−0.096) and the structural component (−0.125), as shown in Columns 2–3, respectively. Note that eq. (1) holds: $-0.223 \approx -0.096 - 0.125$. Therefore, a substantial part of the negative effect of increasing exports on the labour share change can be attributed to the micro-structural component.

The negative industry effect of exports on the labour share (−0.223) reported in Column 1 is a consequence of the fact that exports are associated with higher industry labour productivity (0.170), as shown in Column 4. The relationship between industry labour share change, industry wage growth (Column 7) and

[9] We have considered the idea of using the changes in economic growth in a major trading partner as the source of exogenous variation for export activity, following literature (e.g., Bloom *et al.*, 2011). This approach is very difficult to implement in our context. First, we use a panel of industries and regions to explore the micro-level mechanisms of the labour share. Therefore, we would need an instrument that was correlated with exports at the same level of aggregation. However, recessions in major trading partners are likely to be correlated with export activity at a higher level of aggregation than is needed to construct an instrument for our purposes. Second, the correlation of business cycle fluctuations in different export markets is particularly high for a small open economy because of globalization and growing inter-linkages.

Table 2 Estimation results for the micro-level components of the labour share change, labour productivity growth and wage growth for the years 1978–2007

	Labour share change			Labour productivity growth rate			Wage growth rate		
	(1) total	(2) within	(3) structural	(4) total	(5) within	(6) structural	(7) total	(8) within	(9) structural
d_EXPORT(t − 1)	−0.223**	−0.096	−0.125**	0.170*	0.010	0.160**	−0.043	−0.054	0.013
	(0.076)	(0.066)	(0.046)	(0.078)	(0.069)	(0.052)	(0.055)	(0.054)	(0.009)
d_EXPORT(t − 2)	−0.226**	−0.180**	−0.050	0.165*	0.138*	0.028	−0.059	−0.057	−0.003
	(0.078)	(0.068)	(0.047)	(0.079)	(0.069)	(0.053)	(0.057)	(0.056)	(0.009)
d_FOROWN(t − 1)	−0.011	0.009	−0.021	0.019	0.005	0.016	0.010	0.010	−0.001
	(0.045)	(0.040)	(0.018)	(0.050)	(0.047)	(0.023)	(0.039)	(0.038)	(0.007)
d_FOROWN(t − 2)	0.005	0.020	−0.017	0.032	0.043	−0.009	0.044	0.053	−0.008
	(0.046)	(0.041)	(0.020)	(0.052)	(0.048)	(0.025)	(0.040)	(0.039)	(0.007)
Observations	1440	1440	1440	1440	1440	1440	1440	1440	1440
R-squared	0.057	0.026	0.087	0.019	0.036	0.081	0.097	0.103	0.033

Notes: Coefficients are from Prais-Winsten regressions. Panel-corrected standard errors are reported in parentheses. Observations are weighted by the value added shares. Lagged values are used for the changes in export and foreign ownership shares. All models include the fixed industry-region effects. Statistical significance: $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$.

industry productivity growth given in eq. (5) holds; for example, for d_EXPORT(t − 1) we find that $-0.223 \approx -0.043 - 0.170$.

Column 6 reveals that greater international trade involves intra-industry productivity-enhancing restructuring towards high productivity plants. This pattern is in accordance with the findings in the literature (Bernard and Jensen, 2004; Maliranta, 2005; Bernard *et al.*, 2007). The industry productivity effect is a sum of the within component and micro-level restructuring, i.e. $0.170 = 0.010 + 0.160$.

Column 7 of Table 2 shows that exports have no relationship with industry wage growth. This explains why the productivity effect has such a large dominance in the determination of the labour share change. Exporting has only a weakly significant positive effect on the micro-structural component of industry wage growth (Column 9).

Overall, the estimates reveal that micro-level restructuring is an important channel through which exporting reduces the industry labour share. The effect comes essentially from the restructuring component of labour productivity growth. The restructuring component of industry wage growth has a very minor role to play, which can be seen from the empirical counterpart of eq. (8) for the subcomponents of the restructuring component of labour share change: $-0.125 \approx 0.013 - 0.160$.

The results also point out that the exposure to international trade is clearly a more important determinant of the micro-level components of the labour share change than foreign ownership. Foreign ownership does not have a statistically significant effect on labour productivity or wage growth.

4.1. Decomposition of micro-structural components

So far we have found that the micro-structural components have had an important role in the determination of the labour share and productivity. We next take a closer look at the sub-components of the structural component, as described earlier in eq. (4). This decomposition allows us to pinpoint the exact sources of the effects.

Table 3 reports the estimates for the labour share change. Column 1 in Table 3 is the same as Column 3 in Table 2. It is approximately the sum of the estimates of Columns 2–5 in Table 3 so that one can read the contribution of each sub-component to the structural component. We discover that the negative effect of the structural component on the labour share change emerges largely through the exits of plants, i.e. those plants with a particularly high share of labour income are eventually forced out of business as exports in its industry increase (Column 3). Furthermore, the between component has a negative contribution to the structural component.

Table 4 reports the corresponding results for labour productivity growth. These estimates show that the productivity-enhancing restructuring effect of exports derives essentially from the exit component (Column 3).

Table 3 Estimation results for the structural component of the labour share change

	(1) structural	(2) entry	(3) exit	(4) between	(5) cross-component
d_EXPORT(t − 1)	−0.125**	0.017	−0.115*	−0.074*	0.046
	(0.046)	(0.025)	(0.053)	(0.034)	(0.032)
d_EXPORT(t − 2)	−0.050	0.027	−0.060	0.044	−0.069*
	(0.047)	(0.023)	(0.052)	(0.034)	(0.032)
d_FOROWN(t − 1)	−0.021	0.004	−0.012	−0.003	−0.008
	(0.018)	(0.010)	(0.015)	(0.024)	(0.024)
d_FOROWN(t − 2)	−0.017	−0.023*	0.010	0.000	−0.005
	(0.020)	(0.011)	(0.017)	(0.025)	(0.025)
Observations	1440	1440	1440	1440	1440
R-squared	0.087	0.061	0.092	0.047	0.033

Notes: Coefficients are from Prais-Winsten regressions. Panel-corrected standard errors are reported in parentheses. Observations are weighted by the value added shares. Lagged values are used for the changes in export and foreign ownership shares. All models include the fixed industry-region effects. Statistical significance: $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$.

Table 4 Estimation results for the structural component of labour productivity growth

	(1) structural	(2) entry	(3) exit	(4) between	(5) cross-component
d_EXPORT(t − 1)	0.160**	0.007	0.110*	0.004	0.037
	(0.052)	(0.021)	(0.049)	(0.016)	(0.025)
d_EXPORT(t − 2)	0.028	−0.008	0.052	0.014	-0.016
	(0.053)	(0.021)	(0.049)	(0.016)	(0.025)
d_FOROWN(t − 1)	0.016	−0.006	0.013	0.017+	-0.006
	(0.023)	(0.011)	(0.014)	(0.010)	(0.016)
d_FOROWN(t − 2)	−0.009	0.016	−0.006	0.003	-0.020
	(0.025)	(0.012)	(0.016)	(0.010)	(0.016)
Observations	1440	1440	1440	1440	1440
R-squared	0.081	0.033	0.084	0.108	0.014

Notes: Coefficients are from Prais-Winsten regressions. Panel-corrected standard errors are reported in parentheses. Observations are weighted by the value added shares. Lagged values are used for the changes in export and foreign ownership shares. All models include the fixed industry-region effects. Statistical significance: $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$.

4.2. Robustness checks

To assess the direction of causality between the variables of interest, we have tested the strict exogeneity of the regressors by including the lead values of the explanatory variables (export share and foreign ownership) in the model (Wooldridge, 2002). The results reveal that the lead values of export share and foreign ownership are not statistically significant in any of the nine models that are estimated (Table 5). This supports the conclusion that the causal loop runs from the measures of globalization on the micro-level components of labour share change and not the other way around. This interpretation of our findings is also consistent with the theoretical and empirical literature that underlines the importance of exposure to international trade as a stimulus of restructuring.

To examine the sensitivity of the baseline results, we have performed several checks. First, we have estimated models that also include a variable that measures skill upgrading (i.e. the change in the highly educated) among the explanatory variables to account for the changes in labour supply. Because this variable is not available for the earlier years, these estimations cover the period 1990–2007. In spite of the different period and the slightly different set of explanatory variables the main findings are relatively similar to those made in Table 2 (not reported). We also have estimated OLS models. (The control variables include a full set of the unreported industry-region and year effects.) The central findings for the role of micro-level restructuring remain (Appendix 3). However, the estimated standard errors are much larger than the panel-corrected standard errors from the Prais-Winsten regressions, because the structure of autocorrelation is not taken into account in the OLS estimation (see Beck and Katz, 1995). Furthermore, to examine the robustness we have estimated system GMM panel models that allow us to tackle the potential endogeneity of the measures of globalization with their lagged levels in the dynamic setting (see Blundell and Bond, 1998). The parameter estimates from system GMM panel estimations are relatively close to those reported in Table 2, but they are not statistically significant at the conventional levels (not reported). This is not surprising, because the GMM technique is not a very efficient estimation method in our context.[10] Finally, we have estimated the models of Table 2 separately for each of 12 manufacturing industries. These results reveal an interesting pattern. It turns out that the contribution of international trade to the decline in the labour share has been particularly pronounced within the telecommunication equipment industry that consists of 'communications equipment' (NACE 32–3) (Appendix 4). Therefore, our results point out that the high-tech industries can constitute an important vehicle through which the effects of globalization on the labour share decline manifest themselves in a small open economy.[11]

[10] For efficiency, data should have a large number of cross-sectional observations compared to time-series observations (see Arellano and Honore, 2001).

[11] Since the latter part of the 1990s this sector has been dominated by the manufacture of mobile phones (and Nokia). Thus, the importance of the telecommunication equipment industry is probably specific to Finland.

Table 5 Estimation results for the micro-level components of the labour share change, labour productivity growth and wage growth

	Labour share change			Labour productivity growth rate			Wage growth rate		
	(1) total	(2) within	(3) structural	(4) total	(5) within	(6) structural	(7) total	(8) within	(9) structural
d_EXPORT(t + 1)	0.049	−0.013	0.068	−0.018	0.000	−0.019	0.039	0.037	0.003
	(0.077)	(0.069)	(0.044)	(0.080)	(0.071)	(0.050)	(0.053)	(0.052)	(0.008)
d_EXPORT(t − 1)	−0.229**	−0.099	−0.128**	0.192*	0.034	0.157**	−0.029	−0.037	0.009
	(0.078)	(0.068)	(0.047)	(0.080)	(0.072)	(0.052)	(0.058)	(0.057)	(0.008)
d_EXPORT(t − 2)	−0.229**	−0.180*	−0.054	0.150+	0.118+	0.033	−0.072	−0.068	−0.004
	(0.082)	(0.070)	(0.049)	(0.082)	(0.072)	(0.054)	(0.058)	(0.056)	(0.008)
d_FOROWN(t + 1)	0.017	0.000	0.015	0.006	0.021	−0.015	0.016	0.023	−0.008
	(0.042)	(0.040)	(0.013)	(0.046)	(0.044)	(0.017)	(0.044)	(0.042)	(0.006)
d_FOROWN(t − 1)	−0.013	0.007	−0.021	0.023	0.009	0.016	0.011	0.010	0.001
	(0.046)	(0.040)	(0.019)	(0.050)	(0.048)	(0.023)	(0.039)	(0.038)	(0.007)
d_FOROWN(t − 2)	−0.001	0.024	−0.025	0.033	0.037	−0.001	0.041	0.049	−0.007
	(0.047)	(0.041)	(0.021)	(0.051)	(0.049)	(0.025)	(0.040)	(0.039)	(0.007)
Observations	1392	1392	1392	1392	1392	1392	1392	1392	1392
R-squared	0.063	0.027	0.114	0.024	0.033	0.106	0.082	0.090	0.042

Notes: Coefficients are from Prais-Winsten regressions. Panel-corrected standard errors are reported in parentheses. Observations are weighted by the value added shares. Lagged values are used for the changes in export and foreign ownership shares. All models include the fixed industry-region effects. Statistical significance: $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$.

5. Conclusions

The labour share is an important aggregate variable, subject to possible mistaken policy interventions but mistaken interpretations as well. The labour share of the national income has declined substantially in several industrialized countries during the past few decades. Globalization is likely to have some role to play in directing the changes in the labour shares. Despite the fact that the role of labour market regulations and other institutional aspects affecting the determination of the labour share has gained a considerable amount of attention in the cross-country comparisons (Bentolila and Saint-Paul, 2003; Azmat *et al.,* 2007; IMF, 2007), knowledge of the exact micro-level sources and mechanisms of industry wage growth is absent. Therefore, the determinants of systematic movements in the labour shares are not well understood.

This paper contributes to the literature by distinguishing between two intrinsically different mechanisms underlying the industry labour share changes: (i) the labour share change of the average plant, and (ii) the micro-structural change. Specifically, we take advantage of a useful variant of the decomposition of the labour share, labour productivity, and wage growth in 12 manufacturing industries and four regions to distinguish between the within and micro-restructuring components, through the use of Finnish longitudinal plant-level data. The fact that wage bargaining is so widely and centrally coordinated in the Finnish context makes it an ideal candidate to assess the impact of productivity versus wages as the underlying driver of changes in the wage share. Regression analysis of the micro-level components allows us to examine not only the effects of international trade and other factors on the labour share changes but also to look at the distinct micro-level mechanisms.

The analysis points out the importance of looking at the micro-level mechanisms underlying industry-level changes. The most important empirical finding is that we identify an additional role of the exposure to international trade: there is evidence of a systematic micro-structural change in terms of value added towards those plants that have a lower labour share. Globalization squeezes the labour share because of increasing labour productivity. The labour productivity growth effect of globalization, in turn, predominantly comes through intra-industry restructuring. Furthermore, the negative effect of exporting on industry labour share change emerges largely through the exits of plants, i.e. those plants with a particularly high share of labour income are forced out of business as exports increase. In contrast, wage formation has been largely insulated from the influences of increasing international trade over a period of three decades.

The results imply that the most productive plants had not hired more employees, at least in the short run, up to the point where the differences in the evolution of the labour share between those plants and other plants would be eliminated. The prominent explanation for this pattern, directly linked to globalization, is that the rise in the share of foreign ownership in the manufacturing sector has increased the required return to capital. This could explain why the most productive plants have not expanded their workforce to the extent that would squeeze their profits in a significant way. Furthermore, various kinds of frictions in the labour and capital markets might delay the reallocation of resources between plants so that industries would be in a state of disequilibrium for a long time.

The export share that constitutes our primary measure of globalization has increased more than 20 percentage points over the last three decades, though it varies to some extent between regions and a great deal between industries. According to our estimates this would lead to a decline in the labour share by 10% (or 5–6 percentage points), of which 40% takes place through intra-industry restructuring. The labour share of value added has declined roughly 15 percentage points in Finnish manufacturing over the period 1975–2007. Based on our estimates, globalization is able to explain about one third of this decline. Therefore, there is still a substantial amount in the decline to be explained.

The micro-economic mechanisms empirically identified in the paper are also relevant in the economic context of other advanced economies, and the effects should generalize beyond the Finnish case. Our results carry an important policy lesson. Taken that globalization boosts labour productivity while wages do not fall, it will eventually also benefit employees in the long run. However, this requires flexibility of labour markets so that employees from the exiting plants move to more productive and profitable jobs. Greater wage flexibility between plants would be one way to mitigate this pressure (see Moene and Wallerstein, 1997).

Supplementary material

Supplementary material (Appendices 1–4) is available online at the OUP website.

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References

Agell, J. (1999) On the benefits from rigid labour markets: norms, market failures, and social insurance, *The Economic Journal*, **109**, F143–64.

Aghion, P. and Howitt, P. (2006) Appropriate growth policy: a unifying framework, *Journal of the European Economic Association*, **4**, 269–314.

Arellano, M. and Honore, B. (2001) Panel data models: some recent developments, in J.J. Heckman and E. Leamer (eds) *Handbook of Econometrics*, Vol. 5, Amsterdam, North-Holland.

Azmat, G., Manning, A., and Van Reenen, J. (2007) Privatization, entry regulation and the decline of labour's share of GDP: a cross-country analysis of the network industries, Discussion Paper No. 6348, Centre for Economic Policy Research, London.

Bartelsmans, E.J. and Doms, M. (2000) Understanding productivity: lessons from longitudinal microdata, *Journal of Economic Literature*, **38**, 569–94.

Beck, N. and Katz, J.N. (1995) What to do (not to do) with time-series cross-section data, *American Political Science Review*, **89**, 634–47.

Bentolila, S. and Saint-Paul, G. (2003) Explaining movements in the labor share, *Contributions to Macroeconomics*, **3**, Article 9.

Bernard, A.B. and Jensen, J.B. (2004) Exporting and productivity in the USA, *Oxford Review of Economic Policy*, **20**, 343–57.

Bernard, A.B., Jensen, J.B., Redding, S.J., and Scott, P.K. (2007) Firms in international trade, *Journal of Economic Perspectives*, **21**, 105–30.

Blanchard, O. (1997) The medium run, *Brookings Papers on Economic Activity*, **2**, 89–158.

Bloom, N., Draca, M., and Van Reenen, J. (2011) Trade induced technical change? The impact of Chinese imports on innovation, IT and productivity, Discussion Paper No. 8236, Centre for Economic Policy Research, London.

Blundell, R. and Bond, S. (1998) Initial conditions and moment restrictions in dynamic panel data models, *Journal of Econometrics*, **87**, 115–43.

Chen, X., Lin, S., and Reed, W.R. (2006) Another look at what to do with time-series cross-section data, Working Paper No. 04/2006, Department of Economics, College of Business and Economics, University of Canterbury, Christchurch.

Decreuse, B. and Maarek, P. (2008) FDI and the labor share in developing countries: a theory and some evidence, Document de Travail No. 2008–17, GREQAM, Marseille.

Diewert, W.E. and Fox, K.A. (2009) On measuring the contribution of entering and exiting firms to aggregate productivity growth, in W.E. Diewert, B.M. Balk, D. Fixler, K.F. Fox, and A. Nakamura (eds) *Index Number Theory and the Measurement of Prices and Productivity*, Trafford Publishing, Victoria.

European Commission (2008) *Income Inequality and Wage Share: Patterns and Determinants*, European Commission, Brussels.

Feldstein, M.S. (2008) Did wages reflect growth in productivity? Working Paper No. 13953, National Bureau of Economic Research, Cambridge, MA.

Foster, L., Haltiwanger, J., and Krizan, C.J. (2001) Aggregate productivity growth: lessons from microeconomic evidence, in T. Dunne, J.B. Jensen, and M.J. Roberts (eds) *Producer Dynamics: New Evidence from Micro Data*, University of Chicago Press, Chicago, IL.

Gollin, D. (2002) Getting income shares right, *Journal of Political Economy*, **110**, 458–74.

Guscina, A. (2006) Effects of globalization on labor's share in national income, Working Paper No. 294, International Monetary Fund, Washington DC.

Harrison, A.E. (2002) Has globalization eroded labor's share? Some cross-country evidence, University of California at Berkeley and NBER, Berkeley, CA.

Helpman, E., Melitz, M.J., and Yeaple, S.R. (2004) Export versus FDI with heterogeneous firms, *The American Economic Review*, **94**, 300–16.

IMF (2007) *World Economic Outlook*, International Monetary Fund, Washington, DC.

Jaumotte, F. and Tytell, I. (2007) How has the globalization of labor affected the labor share in advanced countries? Working Paper No. 298, International Monetary Fund, Washington, DC.

Jayadev, A. (2007) Capital account openness and the labour share of income, *Cambridge Journal of Economics*, **31**, 423–43.

Kruger, J.J. (2008) Productivity and structural change: a review of the literature, *Journal of Economic Surveys*, **22**, 330–63.

Kyyrä, T. and Maliranta, M. (2008) The micro-level dynamics of declining labour share: lessons from the Finnish great leap, *Industrial and Corporate Change*, **17**, 1147–72.

Layard, R. and Nickell, S. (1999) Labor market institutions and economic performance, in O. Ashenfelter and D. Card (eds) *Handbook of Labor Economics*, Vol. 3C, Amsterdam, North-Holland.

Lileeva, A. (2008) Trade liberalization and productivity dynamics: evidence from Canada, *Canadian Journal of Economics*, **41**, 360–90.

Mairesse, J. and Kremp, E. (1993) A look at productivity at the firm level in eight French service industries, *Journal of Productivity Analysis*, **4**, 211–34.

Maliranta, M. (1997) Plant-level explanations for the catch-up process in Finnish manufacturing: a decomposition of aggregate labour productivity growth, in S. Laaksonen (ed.) *The Evolution of Firms and Industries. International Perspectives*, Statistics Finland, Helsinki.

Maliranta, M. (2003) *Micro-level Dynamics of Productivity Growth. An Empirical Analysis of the Great Leap in the Finnish Manufacturing Productivity in 1975–2000*, Helsinki School of Economics A-230, Helsinki.

Maliranta, M. (2005) R&D, international trade and creative destruction – empirical findings from Finnish manufacturing industries, *Journal of Industry, Competition and Trade*, **5**, 27–58.

Melitz, M.J. (2003) The impact of trade on intra-industry reallocations and aggregate industry productivity, *Econometrica*, **71**, 1695–725.

Meyer, M. and Winker, P. (2005) Using HP filtered data for econometric analysis: some evidence from Monte Carlo simulations, *AStA Advances in Statistical Analysis*, **89**, 303–20.

Moene, K.O. and Wallerstein, M. (1997) Pay inequality, *Journal of Labor Economics*, **15**, 403–30.

Prais, S.J. and Winsten, C.B. (1954) Trend estimators and serial correlation, Discussion Paper No. 383, Cowles Foundation, Chicago, IL.

Ravn, M.O. and Uhlig, H. (2002) On adjusting the Hodrick-Prescott filter for the frequency of observations, *The Review of Economics and Statistics*, **84**, 371–76.

Ripatti, A. and Vilmunen, J. (2001) Declining labour share: evidence of a change in the underlying production technology? Discussion Paper No. 10/2001, Bank of Finland, Helsinki.

Rodrik, D. (1997) *Has Globalization Gone Too Far?* Institute for International Economics, Washington, DC.

Sauramo, P. (2004) Is the labour share too low in Finland? in H. Piekkola and K. Snellman (eds) *Collective Bargaining and Wage Formation. Performance and Challenges* Physica-Verlag, Heidelberg.

Saxonhouse, G.R. (1977) Regressions from samples having different characteristics, *The Review of Economics and Statistics*, **59**, 234–37.

Solow, R.M. (1958) A skeptical note on the constancy of relative shares, *The American Economic Review*, **48**, 618–31.

Vainiomäki, J. (1999) Technology and skill upgrading: results from linked worker-plant data for Finnish manufacturing, in J.C. Haltiwanger, J. Lane, J.R. Spletzer, J.J.M. Theuwes, and K.R. Troske (eds) *The Creation and Analysis of Employer-Employee Matched Data*, Amsterdam, North-Holland.

Wooldridge, J.M. (2002) *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, MA.

Supplementary material for

Globalization, creative destruction, and labour share change: evidence on the determinants and mechanisms from longitudinal plant-level data

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Appendix 1

Derivation of eqs (1) and (4)

The aggregate labour share is

$$F_t = \frac{\sum_i w_{it}}{\sum_i v_{it}} = \sum_i \frac{v_{it}}{v_t} \frac{w_{it}}{v_{it}} \tag{A.1}$$

In period t plants can be divided into two groups: plants that appeared also in period t-1, (continuing plants, denoted by C) and plants that made an entry after t-1 (entering plants, denoted by E). Then the aggregate labour share can be written as follows:

$$\begin{aligned}
& F_t = \sum_{i\in C} \frac{v_{it}}{v_t} \frac{w_{it}}{v_{it}} + \sum_{j\in E} \frac{v_{jt}}{v_t} \frac{w_{jt}}{v_{jt}} \\
& \Leftrightarrow F_t = \frac{\sum_{i\in C} v_{it}}{v_t} \frac{\sum_{i\in C} w_{it}}{\sum_{i\in C} v_{it}} + \frac{\sum_{j\in E} v_{jt}}{v_t} \frac{\sum_{j\in E} w_{jt}}{\sum_{j\in E} v_{jt}} \\
& \Leftrightarrow F_t = \left(1 - \frac{\sum_{j\in E} v_{jt}}{v_t}\right) \frac{\sum_{i\in C} w_{it}}{\sum_{i\in C} v_{it}} + \frac{\sum_{j\in E} v_{jt}}{v_t} \frac{\sum_{j\in E} w_{jt}}{\sum_{j\in E} v_{jt}} \\
& \Leftrightarrow F_t = \frac{\sum_{i\in C} w_{it}}{\sum_{i\in C} v_{it}} - \frac{\sum_{j\in E} v_{jt}}{v_t} \frac{\sum_{i\in C} w_{it}}{\sum_{i\in C} v_{it}} + \frac{\sum_{j\in E} v_{jt}}{v_t} \frac{\sum_{j\in E} w_{jt}}{\sum_{j\in E} v_{jt}} \\
& \Leftrightarrow F_t = \frac{\sum_{i\in C} w_{it}}{\sum_{i\in C} v_{it}} + \frac{\sum_{j\in E} v_{jt}}{v_t} \left(\frac{\sum_{j\in E} w_{jt}}{\sum_{j\in E} v_{jt}} - \frac{\sum_{i\in C} w_{it}}{\sum_{i\in C} v_{it}} \right)
\end{aligned} \tag{A.2}$$

In a similar manner we can define the aggregate labour share in period t-1:

$$F_{t-1} = \frac{\sum_i w_{i,t-1}}{\sum_i v_{i,t-1}} = \sum_i \frac{v_{i,t-1}}{v_{t-1}} \frac{w_{i,t-1}}{v_{i,t-1}} \tag{A.3}$$

In period t-1 plants can be divided into two groups: plants that survive until period t (continuing plants, denoted by C) and plants that disappear after period t-1.

$$\begin{aligned}
&F_{t-1} = \sum\nolimits_{i\in C} \frac{v_{i,t-1}}{v_{t-1}} \frac{w_{i,t-1}}{v_{i,t-1}} + \sum\nolimits_{k\in D} \frac{v_{k,t-1}}{v_{t-1}} \frac{w_{j,t-1}}{v_{k,t-1}} \\
&\Leftrightarrow F_{t-1} = \frac{\sum\nolimits_{i\in C} v_{i,t-1}}{v_{t-1}} \frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} + \frac{\sum\nolimits_{k\in D} v_{k,t-1}}{v_{t-1}} \frac{\sum\nolimits_{k\in D} w_{k,t-1}}{\sum\nolimits_{k\in D} v_{k,t-1}} \\
&\Leftrightarrow F_{t-1} = \left(1 - \frac{\sum\nolimits_{k\in D} v_{k,t-1}}{v_{t-1}}\right) \frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} + \frac{\sum\nolimits_{k\in D} v_{k,t-1}}{v_{t-1}} \frac{\sum\nolimits_{k\in D} w_{k,t-1}}{\sum\nolimits_{k\in D} v_{k,t-1}} \\
&\Leftrightarrow F_{t-1} = \frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} - \frac{\sum\nolimits_{k\in D} v_{k,t-1}}{v_{t-1}} \frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} + \frac{\sum\nolimits_{k\in D} v_{k,t-1}}{v_{t-1}} \frac{\sum\nolimits_{k\in D} w_{k,t-1}}{\sum\nolimits_{k\in D} v_{k,t-1}} \\
&\Leftrightarrow F_{t-1} = \frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} + \frac{\sum\nolimits_{k\in D} v_{k,t-1}}{v_{t-1}} \left(\frac{\sum\nolimits_{k\in D} w_{k,t-1}}{\sum\nolimits_{k\in D} v_{k,t-1}} - \frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} \right)
\end{aligned} \tag{A.4}$$

By using (A.3) and (A.4) we obtain

$$\begin{aligned}
&F_t - F_{t-1} = \\
&\frac{\sum\nolimits_{i\in C} w_{it}}{\sum\nolimits_{i\in C} v_{it}} + \frac{\sum\nolimits_{j\in E} v_{jt}}{v_t} \left(\frac{\sum\nolimits_{j\in E} w_{jt}}{\sum\nolimits_{j\in E} v_{jt}} - \frac{\sum\nolimits_{i\in C} w_{it}}{\sum\nolimits_{i\in C} v_{it}} \right) - \\
&\frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} - \frac{\sum\nolimits_{k\in D} v_{k,t-1}}{v_{t-1}} \left(\frac{\sum\nolimits_{k\in D} w_{k,t-1}}{\sum\nolimits_{k\in D} v_{k,t-1}} - \frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} \right)
\end{aligned} \tag{A.5}$$

Let us denote

$$\begin{aligned}
&\frac{\sum\nolimits_{j\in E} v_{jt}}{v_t} = S_t^E; \frac{\sum\nolimits_{j\in E} w_{jt}}{\sum\nolimits_{j\in E} v_{jt}} = F_t^E; \frac{\sum\nolimits_{i\in C} w_{it}}{\sum\nolimits_{i\in C} v_{it}} = F_t^C; \\
&\frac{\sum\nolimits_{k\in D} v_{k,t-1}}{v_{t-1}} = S_{t-1}^D; \frac{\sum\nolimits_{k\in D} w_{k,t-1}}{\sum\nolimits_{k\in D} v_{k,t-1}} = F_{t-1}^D; \frac{\sum\nolimits_{i\in C} w_{i,t-1}}{\sum\nolimits_{i\in C} v_{i,t-1}} = F_{t-1}^C
\end{aligned} \tag{A.6}$$

We then get

$$F_t - F_{t-1} = F_t^C - F_{t-1}^C + S_t^E\left(F_t^E - F_t^C\right) - S_{t-1}^D\left(F_{t-1}^D - F_{t-1}^C\right) \tag{A.7}$$

This shows that the aggregate labour share change, i.e. $F_t - F_{t-1}$, is the change in the aggregate labour share change among the continuing plants, i.e. $F_t^C - F_{t-1}^C$, plus the entry effect, i.e. $S_t^E\left(F_t^E - F_t^C\right)$, plus the exit effect, i.e. $-S_{t-1}^D\left(F_{t-1}^D - F_{t-1}^C\right)$.

The change in the aggregate labour share among the continuing plants can be further decomposed as follows:

$$\begin{aligned} &F_t^C - F_{t-1}^C = \frac{\sum_{i\in C} w_{it}}{\sum_{i\in C} v_{it}} - \frac{\sum_{i\in C} w_{i,t-1}}{\sum_{i\in C} v_{i,t-1}} \\ &\Leftrightarrow F_t^C - F_{t-1}^C = 0.5\left(\frac{v_{it}}{\sum_{i\in C} v_{it}} + \frac{v_{i,t-1}}{\sum_{i\in C} v_{i,t-1}}\right)\left(\frac{w_{it}}{v_{it}} - \frac{w_{i,t-1}}{v_{i,t-1}}\right) \\ &+0.5\left(\frac{w_{it}}{v_{it}} + \frac{w_{i,t-1}}{v_{i,t-1}}\right)\left(\frac{v_{it}}{\sum_{i\in C} v_{it}} - \frac{v_{i,t-1}}{\sum_{i\in C} v_{i,t-1}}\right) \end{aligned} \tag{A.8}$$

Let us use the following expressions

$$\begin{aligned} &\frac{\sum_{i\in C} w_{it}}{\sum_{i\in C} v_{it}} = f_{it}; \frac{\sum_{i\in C} w_{i,t-1}}{\sum_{i\in C} v_{i,t-1}} = f_{i,t-1}; 0.5\left(f_{it} + f_{i,t-1}\right) = \bar{f}_i; \\ &\frac{v_{it}}{\sum_{i\in C} v_{it}} = s_{it}; \frac{v_{i,t-1}}{\sum_{i\in C} v_{i,t-1}} = s_{i,t-1}; 0.5 \end{aligned} \tag{A.9}$$

Then, inserting (A.8) into (A.7) we obtain

$$F_t - F_{t-1} = \sum_{i\in C} \bar{s}_i\left(f_{it} - f_{i,t-1}\right) + \sum_{i\in C}\left(s_{it} - s_{i,t-1}\right)\bar{f}_i + S_t^E\left(F_t^E - F_t^C\right) - S_{t-1}^D\left(F_{t-1}^D - F_{t-1}^C\right) \tag{A.10}$$

This formula has been used in Kyyrä and Maliranta (2008). In this paper, we turn this decomposition into a rate form. We can do this by dividing all the terms of (A.10) by the average aggregate labour share, i.e. $\bar{F} = 0.5\left(F_t + F_{t-1}\right)$. Then we have

$$\frac{F_t - F_{t-1}}{\bar{F}} = \frac{\sum_{i\in C} \bar{s}_i \left(f_{it} - f_{i,t-1} \right)}{\bar{F}} + \frac{\sum_{i\in C} \left(s_{it} - s_{i,t-1} \right) \bar{f}_i}{\bar{F}} + \frac{S_t^E \left(F_t^E - F_t^C \right)}{\bar{F}} - \frac{S_{t-1}^D \left(F_{t-1}^D - F_{t-1}^C \right)}{\bar{F}} \quad \text{(A.11)}$$

One of our main goals in this paper is to look at the growth rate of the labour share within the plants. Therefore we would like to develop the first component of the right-hand side of (A.11).

$$\begin{aligned} &\frac{\sum_{i\in C} \bar{s}_i \left(f_{it} - f_{i,t-1} \right)}{\bar{F}} = \frac{\sum_{i\in C} \bar{s}_i \left(f_{it} - f_{i,t-1} \right)}{\bar{F}} + \frac{\sum_{i\in C} \bar{s}_i \left(f_{it} - f_{i,t-1} \right)}{\bar{f}_i} - \frac{\sum_{i\in C} \bar{s}_i \left(f_{it} - f_{i,t-1} \right)}{\bar{f}_i} \\ &\Leftrightarrow \frac{\sum_{i\in C} \bar{s}_i \left(f_{it} - f_{i,t-1} \right)}{\bar{F}} = \frac{\sum_{i\in C} \bar{s}_i \left(f_{it} - f_{i,t-1} \right)}{\bar{f}_i} + \frac{\sum_{i\in C} \bar{s}_i \left(f_{it} - f_{i,t-1} \right)}{\bar{f}_i} \left[\frac{\bar{f}_i}{\bar{F}} - 1 \right] \end{aligned} \quad \text{(A.12)}$$

Inserting (A.12) into (A.11) we get

$$\begin{aligned} &\frac{F_t - F_{t-1}}{\bar{F}} = \sum_{i\in C} \bar{s}_i \frac{\left(f_{it} - f_{i,t-1} \right)}{\bar{f}_i} + \sum_{i\in C} \bar{s}_i \frac{\left(f_{it} - f_{i,t-1} \right)}{\bar{f}_i} \left[\frac{\bar{f}_i}{\bar{F}} - 1 \right] + \sum_{i\in C} \frac{\bar{f}_i}{\bar{F}} \left(s_{it} - s_{i,t-1} \right) + \\ &\frac{S_t^E \left(F_t^E - F_t^C \right)}{\bar{F}} - \frac{S_{t-1}^D \left(F_{t-1}^D - F_{t-1}^C \right)}{\bar{F}} \end{aligned} \quad \text{(A.13)}$$

Appendix 2

Descriptive statistics

Southern Finland	N	Mean	SD	p10	p50	p90
Labour share ch. (total), %	360	-0.767	7.636	-10.686	-0.773	8.294
Labour share ch. (within), %	360	0.230	7.266	-7.883	-0.160	8.262
Labour share ch. (structural), %	360	-0.997	2.731	-3.616	-0.797	1.199
Labour productivity ch. (total), %	360	4.602	8.020	-3.751	4.397	14.460
Labour productivity ch. (within), %	360	3.292	7.528	-5.665	3.171	12.460
Labour productivity ch. (structural), %	360	1.311	3.524	-2.043	1.210	4.892
Wage growth (total), %	360	3.838	5.827	-2.061	4.070	10.180
Wage growth (within), %	360	3.839	5.714	-1.776	4.084	9.965
Wage growth (structural), %	360	-0.001	0.831	-0.758	-0.016	0.795
Export share change, %-points	360	0.571	4.411	-3.416	0.579	5.001
Foreign ownership change, %-points	360	-0.225	7.481	-2.909	0.044	3.562
Highly educated share ch., %-points	192	0.758	2.396	-0.467	0.669	2.353
Eastern Finland						
Labour share ch. (total), %	360	-0.079	9.431	-10.145	-0.388	11.616
Labour share ch. (within), %	360	0.529	8.883	-9.462	0.618	11.272
Labour share ch. (structural), %	360	-0.608	3.711	-3.652	-0.650	2.192
Labour productivity ch. (total), %	360	3.719	9.508	-7.582	4.140	14.853
Labour productivity ch. (within), %	360	3.098	8.790	-7.355	3.427	13.664
Labour productivity ch. (structural), %	360	0.621	4.685	-3.784	0.780	5.350
Wage growth (total), %	360	3.644	5.791	-3.176	3.681	10.297
Wage growth (within), %	360	3.721	5.598	-2.883	3.745	9.780
Wage growth (structural), %	360	-0.076	1.354	-1.292	-0.103	1.229
Export share change, %-points	360	0.364	5.328	-5.563	0.274	6.395
Foreign ownership change, %-points	360	-0.171	8.221	-1.630	0.000	2.514
Highly educated share ch., %-points	190	0.399	2.658	-1.314	0.273	1.781
Western Finland						

Labour share ch. (total), %	360	-0.447	9.019	-9.967	-0.578	8.944
Labour share ch. (within), %	360	0.204	7.324	-8.329	0.229	10.966
Labour share ch. (structural), %	360	-0.651	4.895	-3.124	-0.625	1.024
Labour productivity ch. (total), %	360	3.902	9.554	-5.629	3.671	13.875
Labour productivity ch. (within), %	360	3.036	8.013	-6.838	2.681	12.315
Labour productivity ch. (structural), %	360	0.866	5.873	-3.240	1.048	5.618
Wage growth (total), %	360	3.466	6.030	-3.521	3.163	9.918
Wage growth (within), %	360	3.552	6.014	-3.366	3.259	10.191
Wage growth (structural), %	360	-0.086	0.889	-0.855	-0.129	0.760
Export share change, %-points	360	0.629	3.878	-3.296	0.443	5.064
Foreign ownership change, %-points	360	-0.134	8.188	-2.435	0.000	3.892
Highly educated share ch., %-points	192	0.566	1.653	-0.618	0.473	2.015
Northern Finland						
Labour share ch. (total), %	360	0.283	14.034	-11.761	-1.064	10.962
Labour share ch. (within), %	360	-0.544	8.006	-9.896	-0.689	8.448
Labour share ch. (structural), %	360	0.827	11.122	-5.315	0.024	4.827
Labour productivity ch. (total), %	360	3.400	15.062	-8.730	3.607	16.711
Labour productivity ch. (within), %	360	4.311	8.903	-5.526	3.682	17.716
Labour productivity ch. (structural), %	360	-0.910	13.073	-7.009	0.141	7.059
Wage growth (total), %	360	3.682	7.038	-5.182	4.233	10.423
Wage growth (within), %	360	3.785	6.731	-4.368	4.246	10.476
Wage growth (structural), %	360	-0.103	2.284	-1.664	-0.015	1.302
Export share change, %-points	360	0.637	7.159	-6.213	0.237	7.995
Foreign ownership change, %-points	360	-0.056	6.835	-2.259	0.000	2.883
Highly educated share ch., %-points	192	0.742	2.273	-0.675	0.374	2.369
Total						
Labour share ch. (total), %	1440	-0.544	8.797	-10.510	-0.699	8.763
Labour share ch. (within), %	1440	0.189	7.465	-8.019	-0.034	8.831
Labour share ch. (structural), %	1440	-0.733	4.624	-3.597	-0.648	1.306
Labour productivity ch. (total), %	1440	4.239	9.274	-4.622	4.122	14.356
Labour productivity ch. (within), %	1440	3.272	7.878	-5.828	2.933	12.704
Labour productivity ch. (structural), %	1440	0.966	5.601	-3.252	1.141	5.037
Wage growth (total), %	1440	3.700	5.977	-2.711	3.818	10.180
Wage growth (within), %	1440	3.739	5.871	-2.591	3.890	9.980

Wage growth (structural), %	1440	-0.039	1.062	-0.954	-0.055	0.829
Export share change, %-points	1440	0.578	4.583	-3.820	0.509	5.481
Foreign ownership change, %-points	1440	-0.182	7.708	-2.554	0.000	3.562
Highly educated share ch., %-points	766	0.672	2.207	-0.519	0.537	2.098

Appendix 3

OLS estimation results for the micro-level components of the labour share change, labour productivity growth and wage growth for the years 1978-2007

	Labour share change			Labour productivity growth rate			Wage growth rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	total	within	structural	total	within	structural	total	within	structural
d_EXPORT(t-1)	-0.061	0.014	-0.074+	0.052	-0.073	0.125*	-0.009	-0.027	0.017*
	(0.077)	(0.072)	(0.042)	(0.100)	(0.092)	(0.052)	(0.045)	(0.043)	(0.008)
d_EXPORT(t-2)	-0.089	-0.066	-0.023	0.097	0.074	0.023	0.008	0.011	-0.003
	(0.065)	(0.066)	(0.029)	(0.079)	(0.080)	(0.038)	(0.044)	(0.043)	(0.007)
d_FOROWN(t-1)	-0.006	0.006	-0.012	0.054	0.048	0.006	0.048	0.051	-0.003
	(0.041)	(0.037)	(0.018)	(0.052)	(0.049)	(0.020)	(0.036)	(0.036)	(0.005)
d_FOROWN(t-2)	-0.058	-0.017	-0.042	0.094	0.069	0.025	0.036	0.041	-0.005
	(0.056)	(0.040)	(0.035)	(0.062)	(0.043)	(0.040)	(0.029)	(0.026)	(0.008)
Observations	1440	1440	1440	1440	1440	1440	1440	1440	1440
R-squared	0.184	0.196	0.074	0.137	0.179	0.079	0.313	0.317	0.076
Adj. R-squared	0.157	0.169	0.043	0.108	0.151	0.048	0.290	0.294	0.045

Notes: The estimation method is ordinary least squares. Lagged values used for the changes in export and foreign ownership shares. All models include a full set of the industry-region and year effects. Robust standard errors are reported in parentheses. Weighted by the value added shares. Statistical significance: + p<0.1, * p<0.05, ** p<0.01.

Appendix 4

Estimation results for the micro-level components of the labour share change, labour productivity growth and wage growth in the telecommunication equipment industry (NACE 32-3) for the years 1978-2007

	Labour share change			Labour productivity growth rate			Wage growth rate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	total	within	structural	total	within	structural	total	within	structural
d_EXPORT(t-1)	-0.683***	-0.148	-0.510**	0.625**	-0.040	0.603***	-0.035	-0.092	0.056*
	(0.173)	(0.121)	(0.157)	(0.199)	(0.147)	(0.163)	(0.075)	(0.069)	(0.023)
d_EXPORT(t-2)	-0.560**	-0.382**	-0.176	0.455*	0.422**	0.043	-0.096	-0.109	0.023
	(0.199)	(0.126)	(0.187)	(0.226)	(0.154)	(0.195)	(0.082)	(0.074)	(0.027)
d_FOROWN(t-1)	-0.390	0.009	-0.425	0.163	-0.519	0.645	-0.188	-0.301+	0.111
	(0.432)	(0.319)	(0.374)	(0.500)	(0.379)	(0.398)	(0.194)	(0.180)	(0.067)
d_FOROWN(t-2)	0.840*	0.544*	0.299	-0.866+	-0.267	-0.529	-0.008	-0.007	0.015
	(0.412)	(0.256)	(0.356)	(0.473)	(0.303)	(0.402)	(0.155)	(0.143)	(0.058)
Observations	120	120	120	120	120	120	120	120	120
R-squared	0.262	0.187	0.186	0.179	-0.102	0.193	0.182	0.158	0.081

Notes: Coefficients are from Prais-Winsten regressions. Panel-corrected standard errors are reported in parentheses. Observations are weighted by the value added shares. Lagged values are used for the changes in export and foreign ownership shares. All models include the fixed industry-region effects. Statistical significance: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.