Disentangling Various Explanations for the Declining Labor Share: Evidence from Millions of Firm Records*

Ann Harrison†

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Abstract

This paper uses millions of records from a cross-country and time series database of establishments for France, Germany, Hungary, Sweden, and South Korea to disentangle the role of technological change, intangible assets, market power, and globalization in driving changes in the labor share. This is the first paper using global micro data to embed all 4 drivers of labor share changes in the same framework. As is standard, labor shares are measured as the share of total remuneration to workers in value-added. Technological change is captured using research and development expenditures. Market power is measured using four firm and twenty firm concentration ratios and globalization is measured as export shares in total revenues. The evidence suggests that between 1995 and 2019 important drivers of falling labor shares were globalization and technological change. The impact of market power as measured by four firm concentration ratios is mixed and depends on the country institutional context. We also disentangle the drivers of labor share changes by exploring the determinants of labor demand and wages. Labor demand is significantly and negatively associated with market concentration and technological change, but positively associated with globalization. In contrast, wages are negatively associated with globalization.

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†UC Berkeley, NBER and CEPR. harrison@haas.berkeley.edu

Many studies have addressed the decline in the US labor share, which goes back over several decades. Some excellent papers that provide a broad perspective on the debate include Grossman and Oberfield (2022), Karabarbounis and Neiman (2014), and Elsby, Hobijn, and Şahin (2013).[1] The fall in the share of GDP that goes to labor is not just a US phenomenon. Dao et al. (2017) document that labor shares—usually measured as the share of total compensation to workers in value-added–have fallen in many industrial countries, accounting for at least two thirds of global GDP.[2] Relative to the United States, most other rich countries have had smaller increases due to more activist tax and transfer systems. An important role in mitigating those effects has also been played by institutions such as unions. Card (1996, 1998, 2001) and others have documented the critical role of unions in holding up the bottom of the wage distribution.

Many of the studies that evaluate falling labor shares focus on one leading explanation for the decline, such as labor-saving technical change, or the rise in market power of certain "superstar" firms. Consequently, Grossman and Oberfield (2022) conclude that all these studies "over explain" the decline in labor's share. An econometric interpretation would be that favoring one story induces the standard bias due to omitted variables: if only one right hand side variable is included, its coefficient (in absolute value) could be biased upwards if it takes on a greater magnitude to compensate for all the elements that are excluded from the specification.

This is the first paper to embed four major drivers of labor share changes in the same framework. Consequently, we are able to compare the relative importance of factors such as globalization versus domestic market concentration, using a comprehensive data source known as Orbis. I focus on four of the most popular recent expla-

[1]For a non-technical summary, see the 2019 study by the McKinsey Global Institute. The study authors include James Manyika, Jan Mischke, Jacques Bughin, Jonathan Woetzel, Mekala Krishnan, and Samuel Cudre. For the seminal paper on global labor shares in recent years, see Gollin (2002).

[2]These shifts in labor's share have in turn contributed to higher inequality. Individuals with lower incomes receive most of their income from labor compensation, while individuals who are wealthy receive a large fraction of their incomes through capital ownership. When the fraction of the pie that goes to labor falls, inequality is likely to rise. In fact, it can be shown that falling labor shares are directly associated with rising income inequality as measured by the Gini coefficient. The Gini coefficient can be defined as the sum of the labor share of income multiplied by the concentration index of labor income and capital income multiplied by the concentration index of capital. Since labor income is more equitably distributed across US households than capital income, when the labor share declines the Gini coefficient rises. Jacobson and Occhino (2012) estimate that for the United States a decline in the aggregate labor share of 8 percentage points is associated with an increase in the Gini coefficient of 2 to 3 percent. Consequently, understanding the causes of a declining labor share is important for a broader understanding of why overall inequality has been rising in the United States and elsewhere.

nations for declining labor shares in the economics literature: technological change, the rise in the importance of intangible asset investments, globalization, and market power. Due to the challenges in finding comparable firm level data across countries and over time for all four drivers, I focus on only five countries: France, Sweden, Hungary, Germany, and South Korea.

Figure 1 shows that the average labor share at the company level—defined as total remuneration to employees divided by value added–declined for some countries in our sample (France) but increased in others (Sweden) between 1995 and 2019. Despite Kaldor's beliefs, the labor share is not constant across countries or over time. Many of the explanations for the US decline have suggested that elements of technological change–such as labor-saving innovations or the increasing use of robots–are responsible (see, for example, Acemoglu and Restrepo (2020), Restrepo (2023)).[3] Autor (2013) makes the excellent point that the fear that technology will eliminate jobs has existed for decades if not centuries. We are once again in a period when concerns about the power of innovation to eliminate jobs predominate relative to the evidence that such changes often enhance labor productivity and employment.

In our sample, expenditures on research and development as a share of company revenues have increased, admittedly from a very small base (see Figure 2). While research and development expenditures are only one measure of technology, other measures also show significant increases. Investments in intangible assets, which include patents, trademarks, and software, have increased four times as much as physical assets since 1947, according to Loh, Santaeulàlia-Llopis, and Zheng (2020). Not surprisingly, an important and related strand of the literature on labor shares suggests that these rising investments in both intangible and tangible technologies (like robots) underlie the labor share declines. The significant increase in intangible assets in total assets—which we see in all the countries in our sample as reported in Appendix Table A4–consequently constitutes a second popular explanation for the falling labor share. While intangible asset investments (which include research and development investments) could be thought as a pathway for technology to affect returns to labor, the mechanisms proposed are often different. Loh, Santaeulàlia-Llopis, and Zheng (2020) emphasize the mis-measurement of labor's share when intangible asset returns are not properly attributed to the right factor income. They show that at the macro level for

[3]Much of this literature (see for example Autor (2013) and Autor, Levy, and Murnane (2001, 2002) emphasizes the heterogeneity in impacts across worker types and firms. Routine workers, for example, have been much more affected than other types of workers, as have enterprises producing goods which can be easily replicated in countries like China.

US national accounts, all of the decline in the labor share is eliminated if intangible asset investments are properly accounted for. Another mechanism linking the rise in intangible assets to labor share declines is the fact that their rate of depreciation is much faster than for tangible assets, reducing the share that can go to labor. A third pathway from intangible assets to declining labor shares is through the role of digital transformation in replacing workers not with robots but with innovations like artificial intelligence. [4]

Other authors, such as Autor, Dorn, and Hanson (2013), Pierce and Schott (2016), and Harrison (2005), suggest that globalization may be the cause. These kinds of arguments often rely on the ability of firms to easily relocate to where the cost of labor is lower, while owners of labor are more restricted in their movements. Pierce and Schott (2016) show that China's membership in the WTO led to a strong decline in the growth of manufacturing employment in the United States. They contrast the impact with the EU's experience, arguing that the tremendous decline in US manufacturing employment with China's WTO entry in 2001 did not occur in the EU. They argue that the different experiences of the two regions imply that globalization is more important than technological change.

In a sweeping survey of the literature, Elsby, Hobijn, and Şahin (2013) also conclude that offshoring of labor-intensive activities is likely to be the main cause for declining labor shares. Yet the evidence on globalization is not conclusive. For example, Feenstra, Ma, and Xu (2019) show that between 1991 and 2011 the net job losses from import competition in the United States were offset by the gains to workers in US exporting industries. Others point to the difficulties in disentangling globalization's impact. For example, Karabarbounis and Neiman (2014) emphasize the falling price of investment goods, resulting in part from globalization, in accelerating the replacement of people with machines. In a surprising result, Autor et al. (2020) show that for US sectors, import competition is positively and significantly associated with higher labor shares, which they explain is due to the fact that import competition has negatively impacted value added more significantly than labor compensation. The jury is still out on the effects of globalization, particularly since effects will vary across

[4]Much of the literature has focused less on the role of intangibles and more on tangible asset investments in driving labor share declines, such as robots. Acemoglu and Restrepo (2020) regress changes in wages and employment shares on exposure to robots and find a significant negative effect. Other research strands emphasize a falling price of investment goods (which could also be a consequence of globalization) which has made it attractive for firms to invest in labor-saving technology. Karabarbounis and Neiman (2014) attribute half the decline in the US labor share to a fall in the relative price of capital goods.

skill sets and for importing versus exporting sectors.

A fourth popular explanation for falling labor shares is increasing market power, associated with the rise of superstar firms. Figure 3, using the ORBIS data, shows that the market share of the top four or top twenty companies in many but not all sectors in our sample increased between 1995 and 2019. The rising concentration of business activity is particularly clear for manufacturing but has occurred in other sectors as well. The most prominent of published studies focusing on market power explanations is Autor et al. (2020) who regress changes in labor shares for US sectors on four and twenty firm concentration ratios and show that labor shares are significantly and negatively associated with increases in concentration. Autor et al. (2020) document an increasing concentration of market share in the United States and elsewhere and posit a likely association with greater market power, as companies wrestle excess profits away from labor. Increasing concentration of both wealth and market share has been the subject of both academic (Philippon (2015)) and popular books. Karabarbounis and Neiman (2014) attribute half of the decline in the US labor share to rising markups.

Autor et al. (2020) document for the United States that much of the shift to lower labor shares has occurred as the market share of larger firms with greater market power—and lower labor shares—has increased. If reallocation of market shares towards these kinds of firms has occurred, then we would also expect that weighing labor shares by firm size would lead to an even greater decline. Figure 4 redoes the graphs in Figure 1 but weights the labor share averages taken from Orbis by firm size. The decline is more pronounced for Germany in particular, indicating a reallocation of the labor force towards companies with low labor shares. Given the importance of both within firm changes in labor shares over time and reallocation of market shares towards low labor share firms, in the paper we examine the roles for both forces.

Grossman and Oberfield (2022) are concerned about the lack of identification in many studies of the labor share, emphasizing the challenges associated with cross sectional studies. Through the use of a time series establishment-level panel, we are able to go beyond cross-sectional studies and also are able to address the problem of identification directly using micro data. For the firm level results, our measures of globalization, market power, and technology and intangible investments exclude the firm's own investment or exposure, providing a way of reducing the simultaneity that could likely result from regressing a firm's labor share on its own technology and exporting decisions.

The contributions of this paper are three-fold. First, we embed all four leading explanations of labor share determinants in one consistent approach—addressing the concerns about omitted variable bias voiced by Grossman and Oberfield (2022). Second, we also address simultaneity concerns through our use of micro data and excluding each establishment's own decisions as right hand side variables. Another advantage of using cross-country data is that we are able to use as instruments for each country trends in other countries. Third, in our modeling framework and through the use of different country samples, we show that there is no reason to expect the same impacts of key drivers of labor share changes across countries. In particular, we find that all four drivers have heterogeneous effects across countries. For example, in Sweden concentration is positively associated with labor's share, while in Hungary the impact is negative. As our theoretical framework shows, the relationship between concentration and labor's share is dependent on how the surplus from market power is allocated, which in turn depends on the strength of labor's bargaining power—high in Sweden and low in France or South Korea.

For the labor share results, coefficient estimates for European countries are largest and most negative for research and development expenditures and export activity. However, the magnitudes vary. Traditional trade theory as illustrated by the Stolper Samuelson theorem tells us that in countries with a comparative advantage in producing capital intensive goods opening up to trade would lead to a rise in the return to capital and a fall in the return to labor. In our results, we find a negative impact of globalization on labor shares for France, Germany, and Sweden, but positive impacts on Hungary and Korea.

In this paper, we also explore how these four factors are associated with employment and wage outcomes. Both Autor (2013) and Aghion et al. (2023a, 2023b) point out that technological change could at the same time displace some types of labor but increase overall labor demand as the productivity enhancing impacts of new technology spur employment. Aghion et al. (2023a, 2023b) show that in France, robot adoption has simultaneously led to declining labor shares and increasing labor demand. Our results are mixed. The only factor that is consistently associated with declining employment is market power. The negative relationship between market power and employment is large in magnitude: a 1 percentage point increase in market power is associated with a 2 percentage point reduction in employment at the sector level. In contrast, changes in exports and intangible asset shares as well as tangible assets are associated with increases in employment.

The remainder of the paper is organized as follows. Section I discusses the theoretical literature and also presents a stylized model to understand how various factors could have opposite impacts on labor's share. Section II describes the Orbis data and presents the results on labor shares, employment, and wages at the firm and sector levels. Section III presents extensions that explore endogeneity concerns as well as within versus between reallocation of firm activity and Section IV concludes.

I Theoretical Framework

Our approach combines an imperfect competition framework with bargaining over rents. The theoretical framework allows us to nest the Autor et al. (2020) model as a special case where workers have no bargaining power and therefore an increase in market power need not automatically translate into a lower labor share. The framework also differs from Borjas and Ramey (1995), who examine the link between rising wage inequality and falling industry rents. They assume that the fraction of rents allocated between workers and owners is constant; what changes is the extent of rents as global conditions become more competitive. Borjas and Ramey (1995) and Abowd and Lemieux (1993) also assume that bargaining power is fixed; in this paper, bargaining power varies with the ease of relocation abroad. We include capital in the production function, which allows us to model rent-sharing as a function of both worker bargaining power and capital's bargaining power. The framework is complementary to, but differs from, Rodrik (1997) and Slaughter (2000), who argue that rising labor demand elasticities could shift the incidence of non-wage costs, costs associated with the implementation of labor standards, and government taxes towards labor.

Firms and workers first choose the profit maximizing level of output, and then bargain over the rents. This approach was pioneered by Brown and Ashenfelter (1986) and in the bargaining literature, has come to be known as the efficient bargaining model. An alternative approach would have been to allow employment to be chosen taking into account the negotiated wage, the so-called right to manage model. Like Blanchard and Giavazzi (2003), we propose an efficient bargaining model because we want to capture the possibility that the actual wage may be different from the marginal revenue product of labor. In this framework, the share of rents going to workers depends on the relative bargaining strengths of labor and capital.

We assume there are only two factors of production, labor and capital. The

representative firm uses a vector $\mathbf{v}$ of inputs, with v_L units of labor and v_K units of capital. The competitive return to factors is given by the vector $\mathbf{w}_0 = (w_{L0}, w_{K0})$. The wage under perfect competition would be w_{L0}, and the return to capital would be w_{K0}. Total returns are denoted by the vector $\mathbf{w} = (w_L, w_K)$ with excess returns given by the difference between the two vectors. The utility functions for labor and capital are denoted by:

$$U_L = (w_L - w_{L0})v_L \tag{1a}$$

$$U_K = (w_K - w_{K0})v_K \tag{1b}$$

The revenue function is denoted by $G(\mathbf{P}, \mathbf{v})$. The price vector $\mathbf{P}$, in turn, can be written as a function of the production function $\mathbf{Y}(\mathbf{v})$, so we have $\mathbf{P}(\mathbf{Y}(\mathbf{v}))$. Under imperfect competition, excess profits are equal to:

$$G(\mathbf{P}(\mathbf{Y}(\mathbf{v})), \mathbf{v}) - \mathbf{w}_0 \cdot \mathbf{v} \tag{2}$$

Maximizing (2) with respect to $\mathbf{v}$ yields the following first-order condition:

$$\left[\frac{\boldsymbol{\partial}\mathbf{Y}}{\boldsymbol{\partial}\mathbf{v}}\right]\mathbf{P} = \boldsymbol{\mu}\mathbf{w}_0 \tag{3}$$

The variable μ is the markup given by $\left(\frac{1}{\varepsilon} + 1\right)^{-1}$, where ε is the elasticity of demand. We can implicitly define the optimal choice of $\mathbf{v}$ as:

$$\mathbf{v}^* = \mathbf{R}(\mathbf{P}, \boldsymbol{\mu}, \mathbf{w}_0)$$

The excess rents from (2) can then be written as:

$$\text{Rents} = G(\mathbf{R}) - \mathbf{w}_0 \cdot \mathbf{R} \tag{4}$$

Thus, total revenue, $G(\mathbf{R})$, factor demands, $\mathbf{v}^*$, and total rents are determined by equations (1) through (4) and are independent of labor and capital's bargaining power.

Bargaining Over Rents

Labor and capital bargain to determine their share of the rents. The outcome of bargaining, if we assume Nash bargaining, can be derived from finding the solution to maximizing—over w_L and w_K—the following, which is the product of the surplus each player receives over their so-called threat point:

$$(w_L v_L - U_{L0})(w_K v_K - U_{K0})$$

Before we can solve for returns to labor and capital, we need to define the threat points. We assume that if bargaining breaks down, owners of capital or labor have the option to leave the firm, incur a fixed cost F_L or F_K, and receive alternative returns w_L^* or w_K^*. These alternative returns are not necessarily equal to the competitive return. We will assume that fixed costs are proportional to the quantity of the factor employed, so that we can write $F_i = f_i v_i$. Consequently, we can write the threat points as:

$$U_{L0} = w_L^* v_L - f_L v_L \tag{5a}$$

$$U_{K0} = w_K^* v_K - f_K v_K \tag{5b}$$

So our maximization problem becomes:

$$\max_{w_L, w_K} \{w_L v_L - w_L^* v_L + f_L v_L\} \{w_K v_K - w_K^* v_K + f_K v_K\} \tag{6}$$

over w_L and w_K and subject to:

$$w_L v_L + w_K v_K = G(R)$$

The first-order conditions with respect to w_L and w_K are (where λ is the multiplier on the constraint):

$$v_L(w_K v_K - w_K^* v_K + f_K v_K) = \lambda \tag{7}$$

$$v_K(w_L v_L - w_L^* v_L + f_L v_L) = \lambda \tag{8}$$

Combining these first-order conditions yields the following expression for the wage:

$$w_L = \frac{1}{2}\left[\frac{G(R)}{v_L} + w_L^* + \frac{(f_K - w_K^*)v_K}{v_L} - f_L\right] \tag{9}$$

The expression for the return on capital is analogous to (9). With bargaining, wages depend positively on labor productivity, but now they also depend positively on the alternative returns to labor and the fixed cost to capital of relocating and

negatively on the alternative return to capital and the fixed cost to labor of relocating.

Multiplying both sides of (9) by v_L and dividing both sides by $G(R)$ yields the labor share S_L:

$$\frac{w_L v_L}{G(R)} = S_L = \frac{1}{2} + \frac{1}{2}\left[\frac{w_L^* v_L}{G(R)} - \frac{f_L v_L}{G(R)} - \frac{w_K^* v_K}{G(R)} + \frac{f_K v_K}{G(R)}\right] \tag{10}$$

We can think of the alternative vector $\mathbf{w}^*$ as equal to the competitive return $\mathbf{w}_0$ plus a vector $\mathbf{\Omega}$, which might be positive or negative. If factors receive above their competitive returns because of positive markups, then $\mathbf{\Omega}$ will be greater than zero. But $\mathbf{\Omega}$ could be negative—for example, if a company chooses to close down domestic operations and move to a location where wages or the cost of capital is lower than the home competitive return. So we could rewrite (10) as:

$$\frac{w_L v_L}{G(R)} = S_L = \frac{1}{2} + \frac{1}{2}\left[\frac{(w_{0L} + \Omega_{0L})v_L}{G(R)} - \frac{f_L v_L}{G(R)} - \frac{(w_{0K} + \Omega_{0K})v_L v_K}{G(R)} + \frac{f_K v_K}{G(R)}\right] \tag{11}$$

The expression for capital's share is analogous to (11). If fixed costs of relocating or alternative returns to the factors differ, then excess profits will not be split equally across factors. In particular, labor's share will rise if: (1) alternative returns to labor rise (2) alternative returns to capital fall (3) fixed costs to capital of relocating rise or (4) fixed costs to labor of relocating fall.[5]

To understand what this framework implies for the effects of market power on labor shares, it is helpful to think of a specific form for the production function for output $\mathbf{Y}$. Autor et al. (2020) propose a production function of the general form $Y = A_i L^{\alpha} K^{\beta}$, where A is a firm-specific technology shifter. Using this production function, then equation (3) could be written as:

[5]Using what appears to be a very different approach, which incorporates monopolistic competition, unemployment and Dixit-Stiglitz utility functions in a general equilibrium framework, Blanchard and Giavazzi (2003) also derive an expression for labor's share which is remarkably similar to equation (10). One major difference is that they assume that worker rents are a function of labor market institutions, while we derive the share of rents going to workers as a function of global market factors. Under perfect competition, labor's share will be equal to $w_{L0}v_0/G(R)$, where $G(R)$ is equal to PY and P is equal to marginal costs. In Blanchard and Giavazzi (2003), labor's share is equal to the competitive share, multiplied by $(1 + \mu B)/(1 + \mu)$. Labor's share rises with an increase in bargaining power, which is proxied by B. They do not model the determinants of bargaining power, stating only that they are a function of labor market institutions. In our framework, labor's share is also equal to the competitive share plus a fraction of the excess rents as determined by worker bargaining power. However, bargaining power is determined by global market factors, which are explicitly incorporated into the bargaining framework.

$$\frac{\alpha}{\mu} = \frac{w_{0L} v_L}{PY} \tag{12}$$

Most frameworks (see for example Autor et al. (2020)) assume no bargaining and a labor market where all bargaining power rests with the firm. That would be equivalent to an outcome in the bargaining model where labor ends up at its threat point and the threat point is simply the competitive wage. In a world where firms have market power and retain all the surplus in a bargaining game, then labor's share from (12) is by definition inversely related to the markup μ. Sectors with higher markups—where all the excess profits go to capital owners—will automatically have lower labor shares. One major contribution of the model is to show that higher markups could be associated with lower labor shares but other outcomes are possible. Whether or not greater markups are associated with lower labor shares will depend whether workers share in the surplus, which in turn depends on the relative strengths of the two bargaining units.

What about the role of technology? The framework highlights that the ability of capital owners to easily find alternatives through investment in robots or automation will reduce labor's share. This framework also helps to understand why rising investments in intangible assets could lower the labor share. A new technology like AI could lower labor's alternative return and raise capital owner's alternatives simultaneously. Lower priced robots that can replace workers again could hurt labor by weakening their threat points and strengthening those of capital owners.

Finally, globalization could affect labor's share by affecting either alternative returns or the fixed costs of relocation. A reduction in tariffs or capital controls makes it easier for owners of capital to offshore activities, reducing the labor share in the bargaining model. In a Stolper-Samuelson world, opportunities to trade or offshore activities for the labor scarce countries (like the United States) would likely reduce the alternative wage and employment, while trade in labor abundant countries could increase their alternative returns. We might expect, in this framework, for globalization to have opposite effects on the labor share depending on a country's comparative advantage. Firms in lower wage countries (like Hungary in our sample) have fewer options to relocate to even lower cost locations, driving up labor's share.

II Estimation Results: ORBIS

We begin by presenting the results using the Orbis data, as provided to NBER researchers in a cleaned form and linking individual firms to create an unbalanced panel over time. We keep all observations from 1995 through pre-pandemic years, which includes 2019. We also only retain five countries which report both export data (only 12 countries in the global ORBIS database report this) at the firm level and also exhibit significant coverage as a share of total market activity. This leads us to retain Sweden, France, Hungary, South Korea, and Germany. This reduces the sample size of firm-year observations to 43 million records, although only a quarter of those observations report value added. The distribution across countries is reported in Appendix Table A1. France tops the list, with 62 percent of the total establishment-year observations. Notably poorly represented and excluded from the analysis is the United States, with only 160,000 observations in total representing listed companies.

The main data source for this paper, Orbis, covers both listed and unlisted companies, with coverage varying across countries. While coverage is poor for the United States, for other countries like France most medium and large companies are included even if they are not listed entities. While Orbis has several shortcomings, it is also universally acknowledged as the most consistent and comprehensive firm level database available. Autor et al. (2020) write that "BVD Orbis is the best publicly available database for comparing firm panels across countries". Coverage is particularly good for manufacturing; Kalemli-Özcan et al. (2015) estimate that Orbis accounts for between 60 and 70 percent of manufacturing activity in most European countries. This version of the Orbis dataset has been cleaned under the guidance of Sebnem Kalemli-Ozcan and others in partnership with the National Bureau of Economic Research in order to provide consistency over time. For other excellent research using Orbis, see Gopinath et al. (2017) as well as Gourinchas et al. (2020).

Appendix Tables A2 and A3 show the breakdown by year and by sector. The years with the highest representation are 2001 through 2019. One appeal of the Orbis data is its better coverage in recent years; most analyses of US labor shares stop earlier, such as Autor et al. (2020) which stops in 2012 due to lags in data collection for official census data. One challenge in examining labor shares and calculating market specific measures such as concentration ratios is the need for consistent measures of sectoral company affiliation across countries and over time. Typically, the sectoral breakdown and classifications available vary across countries and over time. This would make it impossible to create concentration ratios that are consistent across more than a

handful of countries. To solve this challenge, we use the Orbis classification which assigns every company to one of 20 sectors. The distribution is listed in Appendix Table A3. While these sectors are less disaggregated than a 2 or 4 digit SIC or NAICS classification, the advantage is that they are consistent across time periods and over time. We can see in Appendix Table A3 that representation is highest for manufacturing and services.

We will estimate regressions with labor share, employment, or wages as the dependent variable and various proxies for technological change, globalization, intangible assets, and market power as independent variables. We report results at both the sector and establishment level. For sector level results, we assume there are sector, country, and time fixed effects. A standard specification for sector j, country c, and year t will be as follows:

$$\begin{aligned} \text{LABOR}_{cjt} = B_1\,\text{TECH}_{cjt} + B_2\,\text{CONC4}_{cjt} + B_3\,\text{INTANG}_{cjt} \\ + B_4\,\text{TRADE}_{cjt} + f_c + s_j + D_t \end{aligned} \tag{13a}$$

With fixed country and sector effects, this specification in first or long differences by country-sector-year can also be estimated as follows:

$$\begin{aligned} \Delta\text{LABOR}_{cjt} = B_1\,\Delta\text{TECH}_{cjt} + B_2\,\Delta\text{CONC4}_{cjt} + B_3\,\Delta\text{INTANG}_{cjt} \\ + B_4\,\Delta\text{TRADE}_{cjt} + D_t \end{aligned} \tag{13b}$$

The dependent variable is either labor share, the log of employment, or the log of the average wage. Labor share is defined as total compensation to all employees divided by value added, reported in Orbis as "costs of employees" and "added value". Over two thirds of the companies included in Orbis do not report one of these variables, which reduces the sample size for the labor share regressions from over 43 million establishment-year million for our chosen sample period and countries (Appendix Tables A1 and A2) to 10 million. Coverage for numbers of employees is similar and includes "total number of employees included in the company's payroll" according to the formal Orbis data definition. Since we do not have individual employee level data, we measure the log of the average establishment level wage as costs of employees divided by number of employees. We measure technology primarily

as research and development expenditures divided by company revenues. However, since many establishments do not report research and development expenditures, this variable should be considered the intersection of both the decision to report non-zero research and development expenditures and its actual value. If the establishment does not report research and development expenditures, we code the variable as zero. We also include a measure of tangible investment in total assets, which are primarily investments in machinery (ie robots) and equipment. Tangible investments and intangible assets are normalized by total assets. The ORBIS definition for tangible fixed assets is "All tangible assets such as buildings, machinery, etc". The definition of intangible fixed assets is "All intangible assets such as formation expenses, research expenses, development expenses and all other expenses with a long term effect". Since our measures of fixed assets overlap with research and development expenditures and could induce collinearity, we report results for these two sets of measures separately.

Exposure to globalization is measured as export revenues as a share of total revenues. We include a dummy variable for missing values for those cases where no data is available. Results are not affected by this inclusion. Finally, we measure concentration using 4 firm and 20 firm concentration ratios. These are the share of the 4 and 20 largest companies in each market segment in each country and year, where market segments are defined as in Appendix A2.

To show consistency with previous results, we begin our analysis at the sector level but then will move to firm level results, which allow us to address endogeneity concerns and explore differences in labor share determinants across countries. Table 1 reports the results at the sector level (see Appendix Table A2 for a list of sectors). All four columns include sector, country, and time fixed effects. This is our equation (13a) above, with sector, country, and time fixed effects. The first four columns enter each of the independent variables separately, to examine whether Grossman and Oberfield (2022)'s hypothesis that focusing on one explanation for labor share changes at a time leads to overexplaining labor's share. The next four columns enter all factors together. If indeed focusing on one explanation at a time leads to biased estimates, then we would expect that the absolute magnitudes in the first four columns are significantly larger than in the last four columns. While some of the coefficients are indeed slightly larger—as for the coefficients on intangibles and on research and development (both negative and significant), in general the point estimates are very close across the first four and last four columns. This indicates that previous studies focusing on one explanation at a time did not seriously bias their coefficients or "over

explain" labor share changes.

In Table 1, the coefficients are relatively stable across specifications, indicating a generally negative association between all four drivers and labor shares. The coefficients on the concentration measures are consistently significant and negative. A coefficient of -0.158 in the first column indicates that if four firm concentration levels were to rise by 10 percentage points then labor shares would fall by a 1.58 percentage point. The coefficient on research and development expenditures varies from -1.011 to -1.096. These coefficients indicate that a 1 percentage point increase in the share of research and development in revenues would be associated with a decline in labor's share from between 1.0 to 1.1. While the magnitude is largest for research and development, the coefficient on intangible assets is also large and negative. The coefficient, which varies from -0.218 to -0.247, indicates that an increase in intangible asset shares of 10 percentage points would be associated with a labor share decline of 2.2 to 2.5 percentage points. Tangible assets are also negatively and significantly associated with labor share reductions, with a magnitude slightly smaller than for intangible assets. The coefficient on sectoral trade, which varies between -0.17 and -0.20, indicates that a 10 percentage point increase in the share of exports in revenues would reduce the labor share by 1.7 to 2.0 percent. The coefficients on the two concentration ratios are of similar magnitude, between -0.15 and -0.17. Consistent with the negative effects of trade shares on labor share, the coefficient on missing trade is significant and positive, indicating that sectors without trade activity have labor shares of 7 to 8 percentage points higher.

We also extend the analysis and transform the data into 5 year long differences. The long difference estimates are reported in Table 2. Since we are taking 5 year differences of both the dependent and independent variables, the coefficients should be directly comparable to those presented in Table 1. Changes in concentration at both the 4 and 20 firm concentration levels become statistically insignificant for sector level labor shares over five years. The association with both intangible and intangible changes in the share of assets are also insignificant for the five year differences. The relationship with research and development expenditures is also insignificant in the long differences. For trade, the relationship is negative and s significant in the long year differences, of larger magnitudes relative to concentration. The impact of export activity in reducing labor's share is largest in magnitude relative to other drivers for the five year long differences, while other factors are less important.

One important concern raised by Grossman and Oberfield (2022) is the over re-

liance in labor share studies on cross-section estimation and lack of focus regarding simultaneity issues. Our framework using enterprise data allows us to also follow the same company over time between 1990 and 2019, and thus the identification can be based on the time series, not only the cross-section—particularly in the first and long differences. To address simultaneity concerns, in the establishment level analysis below we define all right hand side variables at the sector level, excluding the firm's own values. This means that the ratio of research and development expenditures to revenues are calculated at the sector level, excluding that company's research and development in the numerator and its revenues in the denominator. We do the same for the trade share, intangible and tangible asset shares. This means that the trade share for the establishment level regressions exclude the firm's export revenues in the numerator and its revenues in the denominator. Specifically, for firm i in sector j at time t, we have technology defined as:

$$\text{SectorR\&D}_{ijt} = \frac{\sum_{k \neq i}^{n} \text{research\_development\_expenses}_{kjt}}{\sum_{k \neq i}^{n} \text{total\_revenue}_{kjt}} \tag{14}$$

For the regressions, we use a firm-specific measure which follows the overall trend in the ratio of research and development to total revenue as shown in Figure 2, but there is significant variation in firm-specific measures at each point in time when their own contribution is excluded from the sector-level mean. This variation provides the necessary identification for the estimation. We use an analogous definition for tangible and intangible asset shares.

For the 4 firm and 20 firm concentration ratios, we include all companies in calculating the top four and top twenty market shares within each sector, country, and year. However, we exclude the companies that were in the top four and top twenty in the estimation, to avoid simultaneity bias—although the inclusion or exclusion does not affect our basic results. We also apply the same logic for sectoral trade shares. The sectoral trade share for firm i in sector j at time t is defined as:

$$\text{SectorTradeShare}_{ijt} = \frac{\sum_{k \neq i}^{n} \text{exportrevenue}_{kjt}}{\sum_{k \neq i}^{n} \text{totalrevenue}_{kjt}} \tag{15}$$

Our results at the establishment level are reported in Table 3. All results are reported in first differences of both the dependent and independent variables, and all specifications include time effects in the form of yearly dummy variables. The first two columns include measures of tangible and intangible asset shares while the last two columns exclude these but include research and development expenditures. In

the first row, market power as proxied by CR4 (the 4 firm concentration ratio) is negatively related to the labor share. The signs of the two measures of concentration remain negative but the magnitudes are smaller by a factor of 3. Rising investments in tangible and intangible assets are associated with rising labor shares at the enterprise level. However, rising export shares, and rising investments in research and development are negative and statistically significant. The point estimates are comparable to the sector level results. A 1 percentage point increase in export shares is associated with a 0.28 to 0.31 percentage point decline in the labor share. For research and development, a one percentage point increase is associated with a 0.54 to 0.60 reduction in labor share.

A consistent picture emerges across the results reported in Tables 1 through 3. Across every single specification, higher four firm or twenty firm concentration ratios are associated with declining labor shares. However, the largest effects for this sample of countries is associated with rising trade shares and rising research and development expenditures, which negatively impact labor shares. Using a very different dataset, which covers five countries over the 1995 through 2019 period, the results are consistent with those presented in Autor et al. (2020) for market power but point to other more important determinants in terms of the magnitudes. Other factors matter as well—particularly investments in technology and trade activity. Globalization's impacts are also significant and negative for both the sector-level and establishment level results—accounting for three times the impact of concentration.

Our model suggests that the relationship between market power, trade, technology, and labor shares varies as a function of bargaining power. In the model, higher market power need not translate into lower labor shares if labor has stronger bargaining power than owners of capital. The model also suggests that in countries where workers could more easily (less easily) relocate to earn higher alternative returns, we would expect higher (lower) labor shares to be associated with globalization. In Table 4, we redo the establishment level results by three categories of countries, based on differences in union representation and income per capital. Sweden has the highest percentage of represented (union) workers, at 65 percent in 2019; the other countries have less than 20 percent unionized workers. This ranking is similar to a ranking based on GDP per capita. According to the World Bank, Sweden has the highest GDP per capita across the five countries, followed by Germany, then France, and finally South Korea and Hungary.

The results are reported at the country level in Table 4. The different results

are consistent with the predictions of the model, and illustrate the importance of heterogeneity across countries. For Sweden, increasing concentration is associated with increasing labor shares, not declines. This is in contrast to the other countries, where only a small percentage of the workforce is unionized. Other drivers also have heterogeneous impacts across the three groups of countries. While trade shares are negatively associated with labor shares for Sweden, they are positively and significantly associated with labor shares for Hungary and South Korea. For these countries, where the alternative to labor is likely no lower or even higher if labor relocates, trade shares are associated with greater sharing of the wealth.

The results in Table 4 highlight the importance of heterogeneity in country outcomes for all the primary drivers that have been identified in the labor share literature. Outcomes vary across country income levels and institutional context. While the literature on the United States has often treated the conversation as monolithic, the evidence in Table 4 clearly shows that is not the case. Concentration ratios are associated with negative labor shares for four countries in the sample and positive labor shares for Sweden. Export shares have large negative significant impacts on labor shares in Sweden but positive and significant effects in Hungary and South Korea. Research and development shares are associated with negative impacts in Sweden and positive impacts in France and Germany. Our bargaining model, combined with theories of comparative advantage, sheds light on why there might be such heterogeneity in relationships.

One important question is whether declining labor shares—driven by changes in concentration and rising investments in technology—reflect a decline in enterprise employment. In a series of important papers, Aghion et al. (2023a, 2023b) show that while investments in automation is associated with declining labor shares in France, these investments also increased labor demand. Our own analysis of US major employer Amazon inc. shows the same trend—rising profits, falling or stagnant labor shares, and enormous increases in employment. Consequently, we redo the analysis, replacing the dependent variable by labor demand (employment) at both the enterprise and sector level. The results are reported in Table 5.

The first row of Table 5 reports the association between 4 firm concentration ratios and employment at the firm and sector level. Across all specifications, the association is negative and statistically significant. The results are very similar if the 20 firm concentration ratio is used instead. The relationship is very large at the sector level, indicating that a 1 percent increase in 4 firm (20 firm) concentration is

associated with a 0.9 to 1.2 decline (for CR20) in employment. The impact is more than ten times smaller at the establishment level indicating that most of the result is due to reallocation of employment towards more highly concentrated establishments.

While concentration is unambiguously associated with lower labor demand, the results for trade and research and development are also large in magnitude, with opposite effects. Sectoral trade shares are associated with large and positive employment effects at the firm and sector level, with a 1 percent increase in exports associated with a 1.5 to 1.7 percentage increase in labor shares. For sector level research and development, the association with employment is negative and significant. A 1 percentage point increase in the share of research and development expenditures is associated with a12.7 to 13.6 percentage point decline in employment at the sector level. The results in Table 5 suggest that the labor share declines are driven by both increasing market power and higher research and development expenditures—both of which are driving reductions in employment.

The model suggests that under a bargaining framework, then we would expect firms and workers to jointly maximize profits and then share the rents. One implication is that in a setting with greater market concentration and more worker bargaining power, we would expect a positive relationship between concentration and labor's share, but we could expect the same negative relationship with employment as in a setting without worker rights—if that is the outcome that maximizes profits. Recall that in this framework, workers and capital owners jointly maximize profits—thus possibly restricting output relative to the perfectly competitive outcome—and then bargain over the rents This is exactly what we find in Table 6. For all countries, an increase in concentration is associated with a fall in employment. The effects, however, are small: a 10 percent increase in concentration is associated with a .02 to 0.6 percent decline in employment. The positive association between export shares and employment is positive and significant for all the countries in the sample, despite differences in underlying comparative advantage. More export activity is clearly associated with higher employment outcomes, at both the establishment and sector level, across different income levels.

Table 7 repeats the analysis at the sector level, for five year differences. The results are very similar to the previous table. The largest and most negative association is with market concentration, where a one percentage point increase is associated with a 0.6 (CR4) to 1.4 (CR20) percentage point decline in employment. As with the establishment and annual sector level results, research and development expenditures

are negatively associated with employment. A 1 percentage point increase in Research and Development shares is associated with an 12.3 to 13.2 percentage point decline in employment, suggesting evidence of labor substituting technical change. Only export shares are positively and significantly associated with employment growth, consistent with annual results at both the establishment and sector level. The magnitude is large: a 1 percent increase export shares is associated with a 2.4 percent increase in employment.

The results in Tables 5, 6 and 7 are consistent with Aghion et al. (2023a, 2023b) showing that investments in automation and machinery are positively associated with employment in France. In addition, by expanding the analysis to explore the relationship with concentration and export shares, we show that concentration is unambiguously negatively associated with employment, while the relationship with trade is generally positive. One implication of the results are that employment outcomes are positively associated with less concentrated market structures and expansion of trade opportunities but negatively concentrated with labor-saving technological change.

One implication of a negative impact of globalization on labor shares and a positive impact on employment is that the negative consequences for wages should be large. We use our establishment level data on total compensation and total number of employees at the establishment level to calculate an average wage at the establishment level. This could also be thought of as average compensation or average cost of employees. The log of this measure is the dependent variable in Table 8. The only factor which shows a consistent relationship across the establishment level and sector level results is globalization. As expected, higher export shares are associated with significantly lower average wages. A one percent increase in export shares is associated with a 1.6 (at the establishment level) to 2.2 (at the sector level) reduction in average wages. The evidence suggests that globalization is associated with higher overall employment, significantly lower wages, and consequently lower labor shares.

Other results are mixed. Investments in both tangible and intangible assets as a share of total investment are generally associated with positive and significant effects on wages. Market power is associated with a negative impact on wages at the establishment level but a positive impact at the sector level. One factor could be that the establishment level data excludes the top market share enterprises to avoid endogeneity. Thus the results suggest that smaller market share enterprises respond with lower wages, but that overall there is some sharing of the rents with workers at the sector level. The results are also mixed with research and development, indicating

negative effects at the establishment level but positive and insignificant effects at the sector level.

III Robustness Tests and Extensions: Endogeneity and Reallocation

Our modeling framework focuses in workers and firms bargaining over rents when there is imperfect competition. In such a framework, we would assume that a big fraction of this bargaining occurs within an establishment, indicating that a large fraction of changes in labor shares should occur over time within the same enterprise. Since much of our innovation is to focus on within establishment changes, the identification for the micro level exercises assumes that a big component of these international trends occur within the firm. On the other hand, Autor et al. (2020) have a model where most of the changes in labor shares occur through reallocation as low labor share enterprises expand and take on more market share at the expense of high labor share firms. This possibility is one of the reasons we report both establishment level and sector level results. Nevertheless, it is instructive to show the decompositions to see where these five countries stand in this debate.

A standard decomposition can be transformed from the Olley and Pakes exercise for productivity to examine labor share changes, as did Autor et al. (2020). This means we will have the following equation for changes in sector level labor shares:

$$\Delta S = S_1 - S_0 = \Delta \overline{S} + \Delta \left[\sum_i (\omega_i - \bar{\omega})(S_i - \bar{S}) \right]$$

The overall sector-level change in the labor share between period 0 and period 1 can be decomposed into the change in labor shares within individual enterprises and reallocation across establishments. The results for this exercise are reported in Table 9, as well as in Figures 5 and 6. The results in Table 9, shown in Figure 5 in bar chart form, reveal that both within-establishment changes as well as between-establishment changes contributed to labor share shifts. Overall, within-establishment changes were larger, particularly for Sweden. The only country where between-establishment changes dominated was Germany. As an illustration, the total increase in labor share for Sweden between 2002 and 2019 was 5.41 percent. This reflected the 9.65 percent increase in the within-firm labor share and the -4.24 percentage point decline due to between-firm changes. For France, the within-firm decline in

the labor share also dominated, with a 2.37 percentage point decline compared to a 0.28 percentage point decline in the between-firm component. Most of the between-firm components were negative, reflecting a reallocation of market share towards low labor-share firms. Three out of the countries had positive within-firm labor share increases.

As shown in Figure 5, the importance of within versus between firm changes varied over the sub periods of the sample. For example, between firm changes were larger between 2003 and 2008, which includes the period of the 2007 financial crisis. Other sub periods show bigger movements due to within firm changes. Figure 6 reports the within and between firm components of labor share changes for manufacturing and non-manufacturing establishments separately. Both factors are important across countries. Between firm changes are slightly more important for manufacturing establishments, with the exception of Sweden where within-firm changes predominate. The evidence in Figures 5 and 6 suggests that both within and between establishment changes played an important role overall in labor share changes, suggesting that a focus on within firm behavior as well as the sector-level is warranted.

The second area that we explore is an alternative approach to endogeneity concerns. The primary approach in this paper to potential endogeneity is using sector-level determinants with firm-level regressions where each of the sector-level elements exclude that firm. One potential concern is the so-called reflection problem, as coined by Manski. In addition, our sector-level results cannot apply the firm exclusion approach we use with the micro data. Consequently, we also explore the use of more standard instrumental variable techniques in Table 10. For each right-hand side variable, we use as instruments all the same sector and year specific values for the other four countries in the sample. For example, the instruments for CR4 for France would be the CR4 values for the same year and sector in Germany, Hungary, South Korea and Sweden.

The first three columns of Table 10 use annual data, while the last three report the five year long differences. The first stage F tests show that the instruments have strong predictive power in the annual data but perform poorly for the five year long differences. In the firm three columns, the value of the first stage F statistic ranges from 18 (for research and development) to 111 (to CR4). These values indicate that other country values are particularly effective for concentration ratios and trade shares, but also sufficient for research and development when using annual data series.

The results for the Two Stage Least Squares estimates are consistent with the OLS

results presented earlier in the paper. The four firm concentration ratio negatively and significantly impacts the labor share; the coefficient of -0.15 is consistent with previous OLS estimates. Sector level trade shares negatively affect the labor share, although the point estimate is not statistically significant at conventional levels. Sector level research and development has the largest negative impact: a 1 percentage point increase in research and development shares is associated with a 2.6 percentage point reduction in the labor share. The next two columns decompose the labor share decline into employment and wage effects. The results suggest that the negative impact of concentration on the labor share is primarily driven by a negative impact on wages. Sector-level trade positively impacts employment but negatively impacts wages, as we found earlier in the paper. The magnitudes are large and significant. A 1 percent increase in exports as a share of revenues is associated with a 2 percent increase in employment and a 1.4 percent decline in wages. The largest impacts are associated with research and development. A one percentage point increase in sectoral research and development as a share of revenues is associated with a 15.5 percentage point decline in employment and a 2.5 percentage point decline in wages, but only the employment effects are significant.

While the instrumental variable results are not as precise as the earlier results with establishment level data and sector level data, they are nevertheless consistent with previous results. All three drivers show significant negative impacts on labor share, with the largest impacts stemming from research and development and globalization. Those negative impacts, in turn, are driven by the labor displacing effects of technology for research and development and the downward pressure on wages for trade shares.

What do all these results mean for actual labor share declines? There have been extensive debates on whether the US labor share declines are driven by technology, trade, market power, or other forces. How do the results in this paper shed light on that debate? The coefficient estimates across specifications are around -0.15 for four firm concentration ratios, between -0.18 (for the IV estimates) and -0.30 (for the establishment level and sector level estimates) for export shares, and even larger for research and development. For research and development expenditures, the estimates range from -0.50 (at the establishment level) to -2.6 (for the IV results). We can combine these coefficients with actual changes in these values over time to gauge a rough estimate of the actual impact.

Most estimates of concentration ratios, including those presented in our Appendix

Tables and those presented in Autor et al (2020) show either declines in concentration or small increases. Autor et al (2020) show a 1 percentage point increase in concentration for manufacturing within the time period they study. This would imply a 0.15 percentage point decline in the US labor share. The impacts of trade changes are larger. According to the World Bank, average export shares in GDP globally between 1970 and 2020 increased by 30 percentage points. For France, the increase during that period was 20 percentage points, and for the US it was smaller–doubling from 5.7 percent in 1970 to 11.8 percent in 2022. Multiplying those changes with the -0.30 estimate from our establishment level and sector level analyses suggests labor share declines of 10 percentage points for the world, 7 percentage points for France, and 1.8 percentage points (6.1 x 0.3) for the United States.

What about the impact of research and development, our proxy for technology? Research and development shares have only increased slightly—from 1 percent for businesses in the United States in 1970 to 2.7 percent in 2023 according to the NSF, suggesting a net increase of 1.6 percentage points. For the US, this would imply a labor share decline of 0.8 percent (1.6 x 0.5) if we apply the estimates from Table 3 or 4.4 percent using Table 10 (1.6 x 2.6). Combining national trends in these drivers with our point estimates implies that for the United States the biggest factors driving labor share changes were technology and globalization, and the smallest driver was market power. Whether technology or globalization is the leading factor depends on which coefficient estimates we use, suggesting that both may be equally important.

Nevertheless, it is difficult to generalize the impacts since both the signs and magnitudes of labor share drivers vary across countries. Table 4 shows that for Hungary and South Korea, increasing globalization is associated with labor share increases; for France and Germany, technological change is associated with labor share increases as well; for Sweden, increasing concentration has a positive impact on the labor share.

IV Concluding Remarks

This paper uses company level data from a global database (Orbis) to explore the relative importance of four popular explanations for the decline in the labor share. We focus on four possible drivers: market power, technological change, intangible asset investments, and globalization. The contribution of the paper lies in its consistent and broad coverage across 5 countries, allowing the comparison of different drivers

using company records assembled by a single data source Orbis, and our ability to use time series and micro data to address possible endogeneity concerns.

The results at the sector levels indicate that all four drivers are associated with declining labor shares. The magnitude is greatest for technology and globalization. If we measure technical change with firm-level research and development shares in sales, we find that technology has a significant negative impact on labor shares and employment. A 1 percentage point increase in research and development expenditures as a share of revenues is associated with a 0.5 to 2.6 percentage point decline in labor's share. Globalization is also important. A 1 percentage point increase in export shares is associated with a 0.3 percentage point reduction in labor share. However, globalization is generally associated with increases in employment, particularly for lower income countries. The implication is that wages are largely and negatively affected by globalization activity in our sample, which is confirmed by the wage-level analysis.

Market power, as measured by four or twenty firm concentration ratios is associated with a decline in labor's share in non-unionized countries but associated with an increase in labor share in a highly unionized country like Sweden. Everywhere, however, more market concentration is associated with lower employment. A 1 percentage point increase in the four firm concentration ratio is associated with a 0.12 to 0.15 decline in labor share at the aggregated sector level. The magnitudes are remarkably consistent with Autor et al. (2020) who focused on the United States using census data.

As shown in the model, there is no a priori reason why higher markets need to translate into lower labor shares unless we make the assumption that firms have market power in product markets and workers have no market power in factor markets. If instead, as our model shows clearly, we assume that firms and workers maximize profits and then bargain over the surplus, it is perfectly plausible that higher concentration (and thus higher markups in a Cournot setting) are associated with higher labor shares. We show that this is the case for Sweden.

One implication of these results is that efforts to impose protectionist measures could have a smaller impact on employment relative to encouraging less concentration or promoting technological change in the direction of labor-using rather than labor-reducing technology. The results point also to the power of worker representation in creating more opportunities to increase labor share. Policies which bias firm expansion towards capital investments instead of labor (such as subsidies to capital investments

versus higher taxes on payroll) could be targeted if the goal is to increase the labor share. The positive relationship between labor shares and export activity in Hungary also points to the likely benefits of globalization for returns to labor in middle income market countries.

The results also point to the importance of distinguishing between factors associated with labor share declines and positive employment effects. Changes in intangible asset investments are associated with labor share declines but employment increases. Only one driver is clearly associated with both labor share declines as well as employment declines: market power. Rising concentration is associated with unambiguous declines in both labor shares and employment for all countries except Sweden.

Although there is significant heterogeneity across countries, the sector level and establishment level results show remarkable consistency. The largest negative effects on labor share come from globalization as measured by exports and technical change as proxied by research and development intensity. Market power also matters, but the magnitudes are smaller. When we decompose these labor share changes into employment and wage effects, the results are also consistent across sector and establishment specifications, and across OLS and two-stage least squares estimates. Globalization drives labor share declines through large negative wage effects, offset by positive employment impacts. For technical change, the labor share declines are driven by negative employment effects.

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Figure 1. Labor Shares in Orbis as a share of value added: Unweighted Means

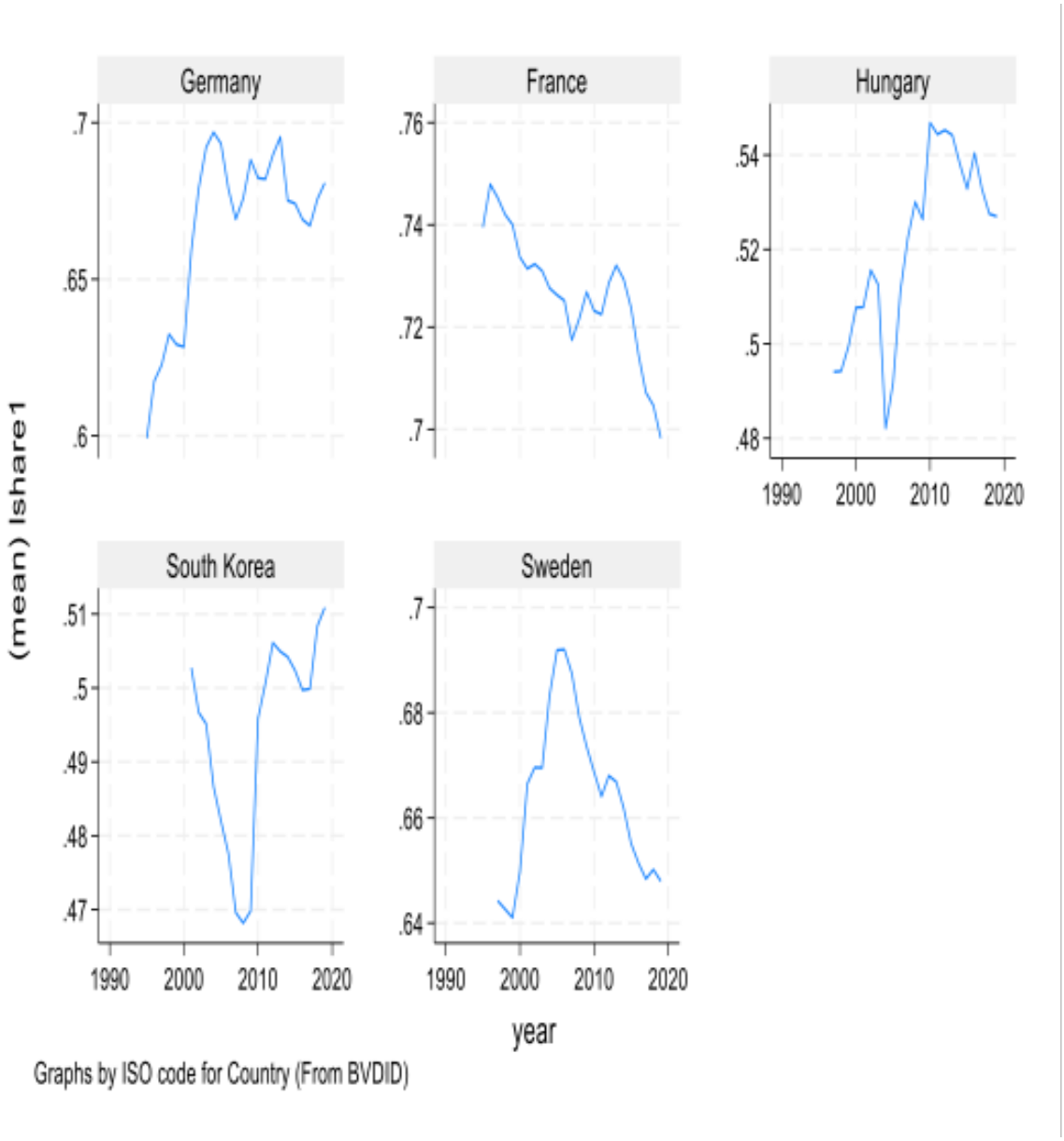

Figure 2. Sectoral Research and Development

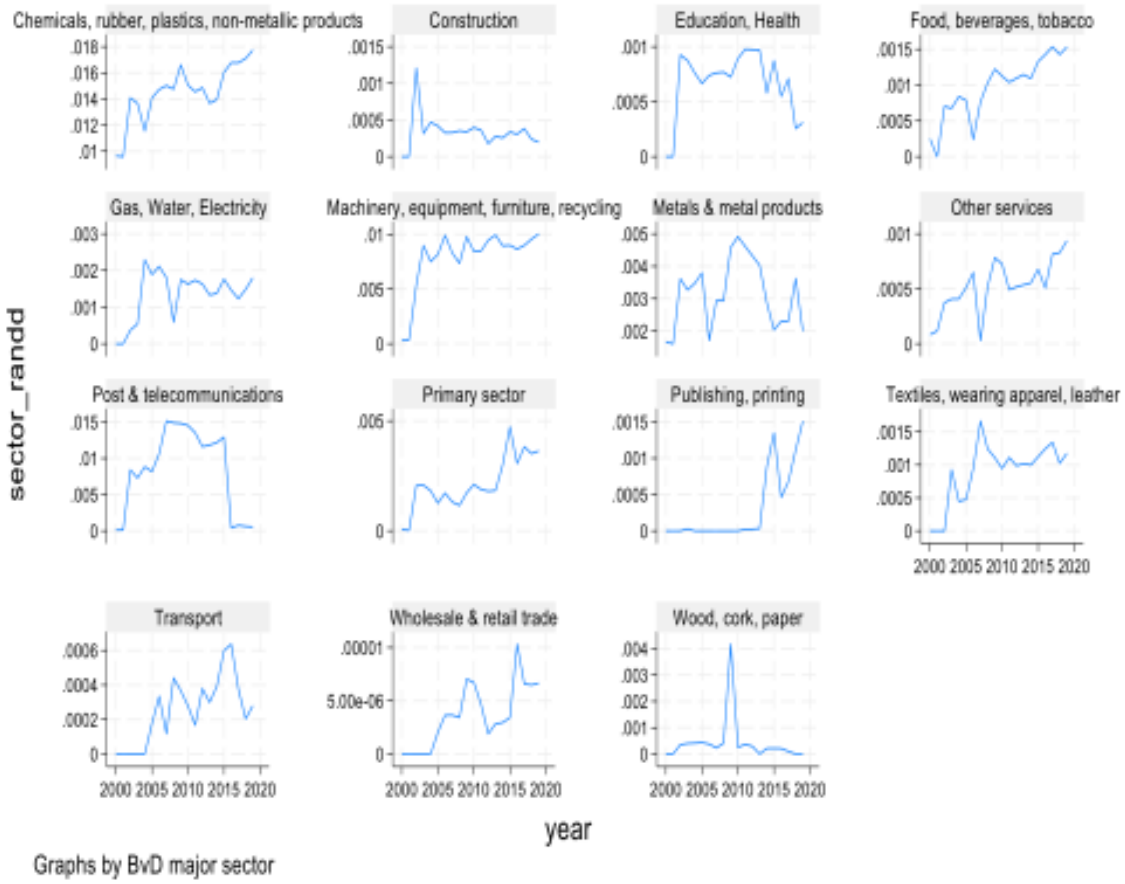

Figure 3. CR4 and CR20 Measures of Market Concentration, by Sector (Orbis Dataset)

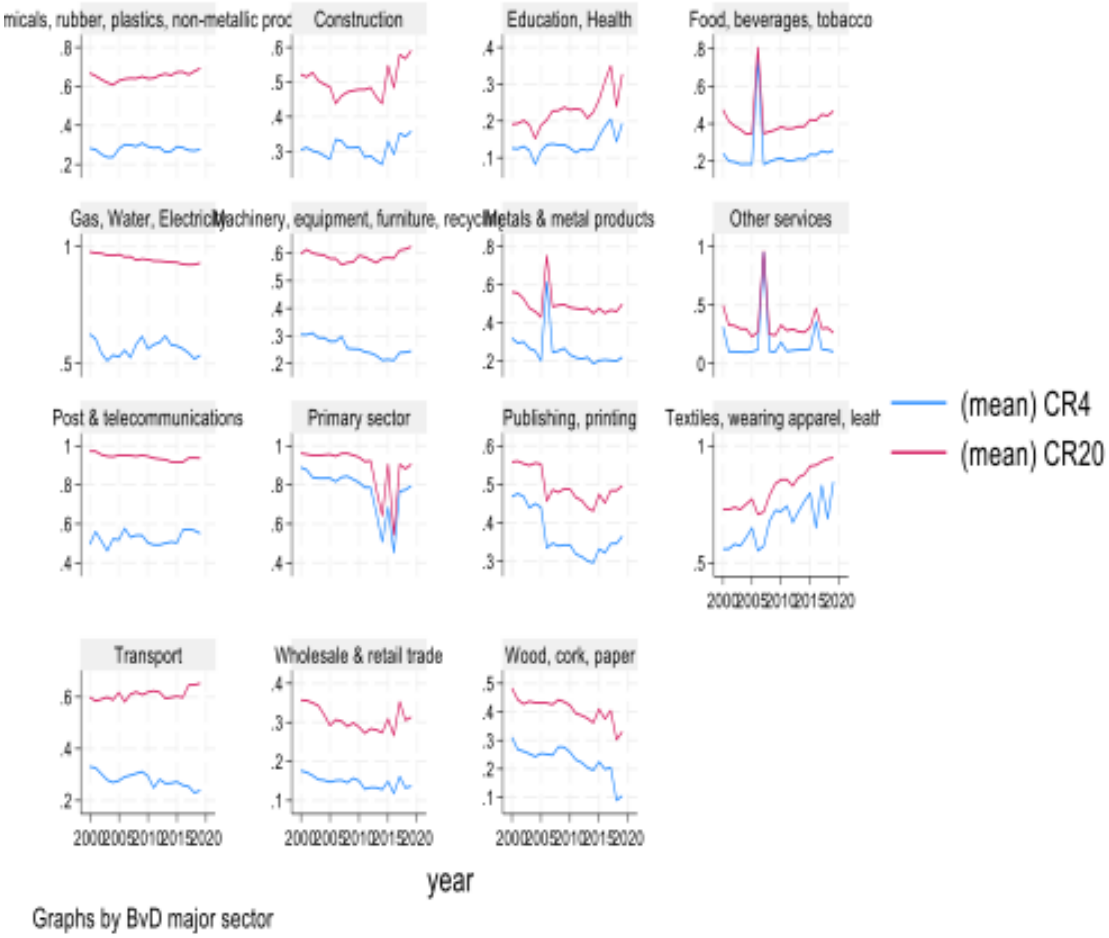

Figure 4. Labor Shares in Orbis as a share of value added weighted by Firm Size (Sales)

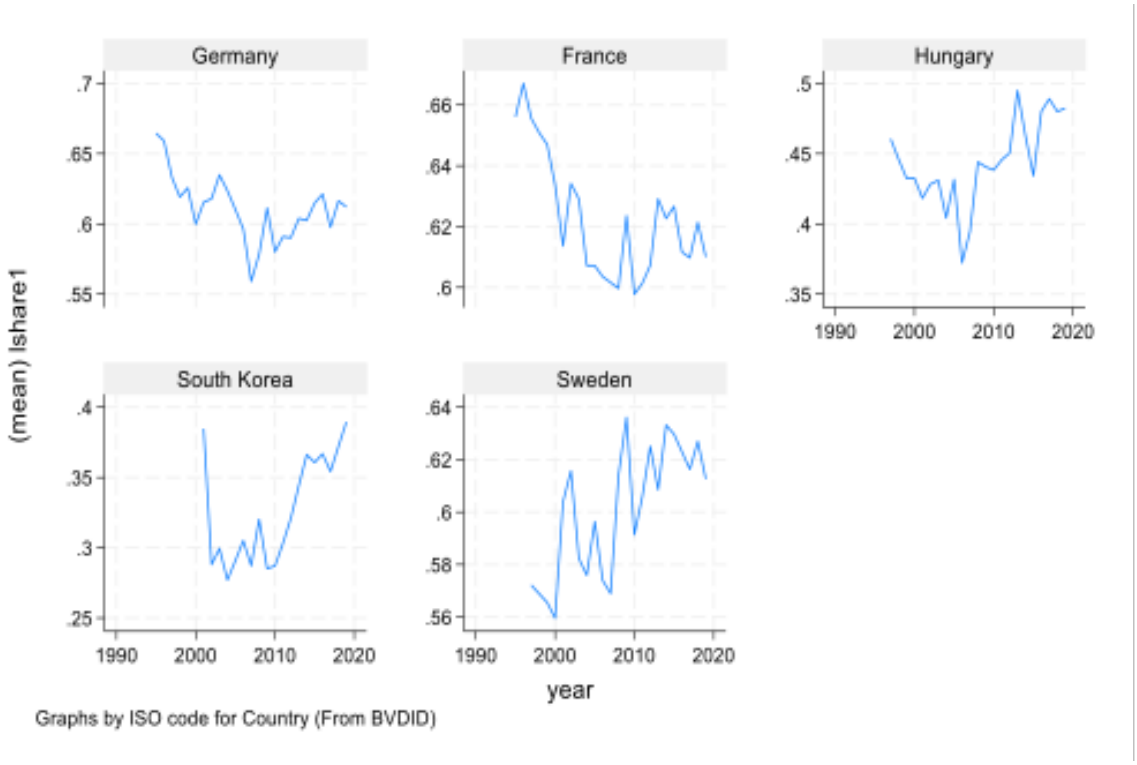

Figure 5

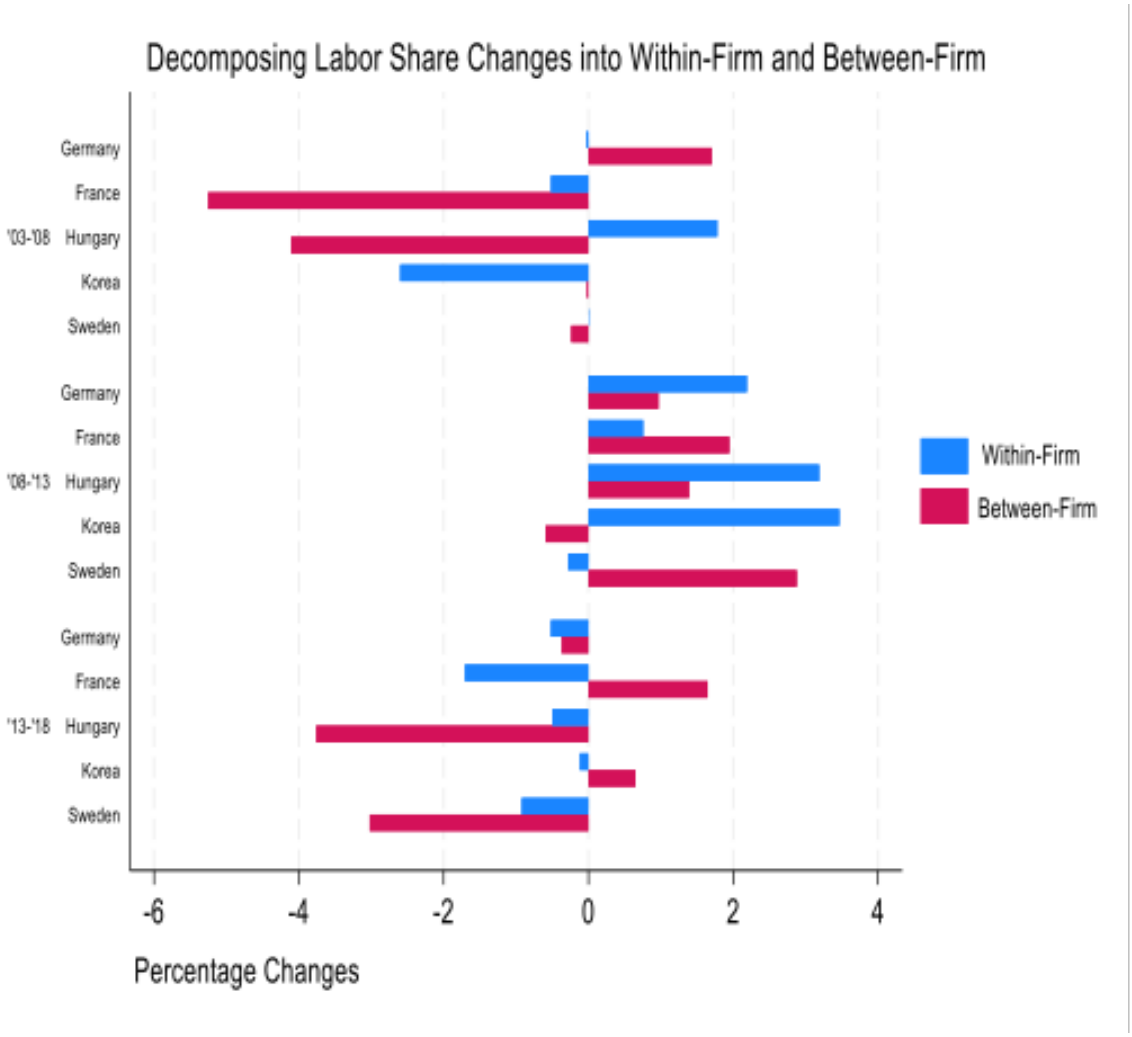
Decomposing Labor Share Changes into Within-Firm and Between-Firm
Germany
France
'03-'08 Hungary
Korea
Sweden
Germany
France
'08-'13 Hungary
Korea
Sweden
Germany
France
'13-'18 Hungary
Korea
Sweden
-6
-4
-2
0
2
4
Percentage Changes
Within-Firm
Between-Firm

Figure 6

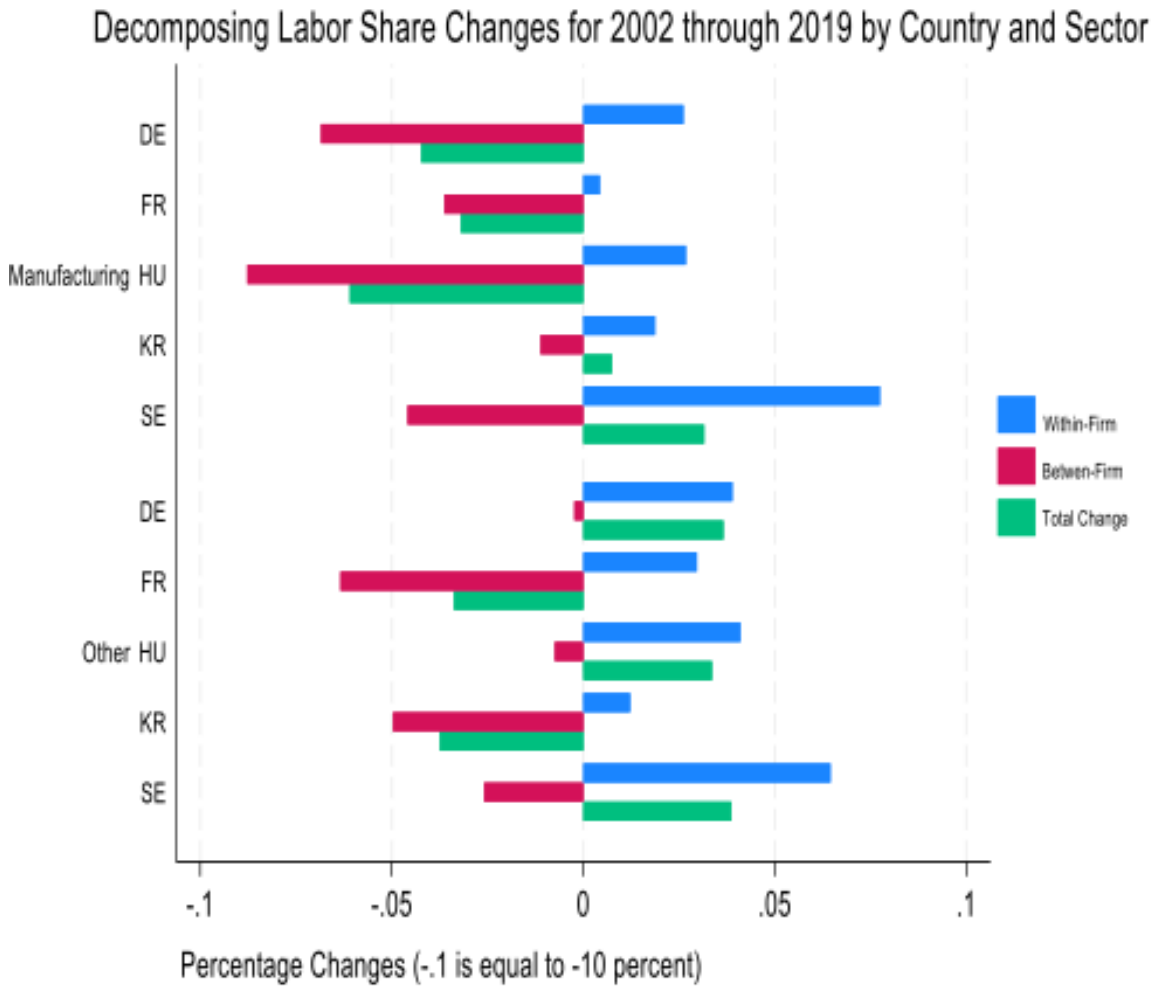
Decomposing Labor Share Changes for 2002 through 2019 by Country and Sector
Manufacturing
Other
DE
FR
HU
KR
SE
DE
FR
HU
KR
SE
Within-Firm
Between-Firm
Total Change
-.1
-.05
0
.05
.1
Percentage Changes (-.1 is equal to -10 percent)

Table 1. Sector Level Results

Dependent Variable: Labor Share	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CR4 (Four firm Concentration ratio)	-0.177 (0.023)**				-0.158 (0.024)**		-0.173 (0.023)**	
Sector level share of Tangible assets in Total assets		-0.196 (0.036)**			-0.201 (0.035)**	-0.213 (0.035)**		
Sector level share of Intangible assets in Total assets		-0.305 (0.062)**			-0.218 (0.064)**	-0.247 (0.063)**		
Share of research and development expenditures in total sales at sector level			-1.249 (0.454)**				-1.096 (0.445)*	-1.011 (0.451)*
Share of exports in sales at the sector level				-0.174 (0.036)**	-0.187 (0.036)**	-0.202 (0.036)**	-0.173 (0.036)**	-0.185 (0.036)**
CR20						-0.151 (0.027)**		-0.160 (0.026)**
Missing Trade					0.070 (0.011)**	0.078 (0.011)**	0.073 (0.011)**	0.079 (0.011)**
R^2		0.55	0.54	0.55	0.58	0.57	0.57	0.56
N		1,846	1,846	1,846	1,846	1,846	1,846	1,846

Notes: All columns report levels specifications which include sector fixed effects, year fixed effects, and country fixed effects. All variables are aggregated to the sector level. Labor share is defined at the sector level as total payments to employees divided by value-added. Research and development share is the share of reported expenditures divided by total revenues at the sector level. Trade shares are the share of exports in revenues at the sector level. A * indicates significance at 5 percent and a ** indicates significance at 10 percent.

Table 2. Long Differences at the Sector Level: Determinants of Labor Shares (Five Year Differences)

Dependent Variable: Change in Labor Share				
	(1)	(2)	(3)	(4)
Change in CR4	-0.035 (0.036)		-0.036 (0.035)	
Change in R and D Share			0.792 (0.694)	0.802 (0.695)
Change in Export share	-0.291 (0.058)**	-0.295 (0.058)**	-0.293 (0.058)**	-0.297 (0.058)**
Change in Share of tangible assets	-0.010 (0.061)	-0.010 (0.061)		
Change in Share of intangible assets	-0.027	-0.046		
Change in CR20		0.010 (0.047)		0.004 (0.046)
Missing Trade	-0.002 (0.009)	-0.001 (0.009)	-0.002 (0.009)	-0.002 (0.009)
R^2	0.05	0.05	0.05	0.05
N	1,341	1,341	1,341	1,341

Notes: All four columns report long difference specifications and include year fixed effects. All variables are aggregated to the sector level. Labor share is defined at the sector level as total remuneration divided by value-added. Research and development share is the share of expenditures divided by total revenues at the sector level. Trade shares are the share of exports in revenues at the sector level. A * indicates significance at 5 percent and ** at 1 percent level.

Table 3. Firm Level Determinants of the Labor Share

Dependent Variable: Change in Labor Share				
	(1)	(2)	(3)	(4)
Change in CR4	-0.033 (0.001)**		-0.025 (0.000)**	
Change in share of Intangible assets At the Sector Level	-0.001 (0.002)	0.007 (0.002)**		
Change in share Of tangible assets At the Sector Level	0.026 (0.002)**	-0.017 (0.002)**		
Change in CR20		-0.009 (0.001)**		-0.020 (0.000)**
Change in Export Share At the Sector Level	-0.283 (0.001)**	-0.275 (0.001)**	-0.308 (0.001)**	-0.299 (0.001)**
Change in R and D Share			-0.596 (0.034)**	-0.543 (0.034)**
R^2	0.01	0.01	0.01	0.01
N	10,429,078	10,429,078	10,594,222	10,594,222

Notes: All are first difference results. Time effects included in all specifications whose coefficients are not reported here. Labor share is defined at the establishment level as total renumeration divided by value-added. Research and development share is the share of expenditures divided by total revenues at the sector level. Trade shares are the share of exports in revenues at the sector level. Intangible and tangible assets are changes at the sector level in the share of tangible or intangible assets in total assets. RDSHARE, Trade share, tangible and intangible asset shares also exclude firm i. For establishment level regressions only, top 20 firms in terms of market share excluded.

Table 4. Firm-Level Results by Country

Dependent Variable: Change in the Labor Share at the Establishment Level						
	Sweden	France and Germany	Hungary and South Korea	Sweden	France and Germany	Hungary and South Korea
Change in CR4	0.007 (0.007)	-0.003 (0.001)**	-0.013 (0.003)**	0.016 (0.007)*	-0.000 (0.000)	-0.012 (0.003)**
Change in share of Intangible assets at the Sector Level	-0.013 (0.007)*	0.006 (0.002)**	0.008 (0.006)			
Change in share of Tangible assets at the Sector Level	0.063 (0.010)**	0.008 (0.002)**	0.013 (0.008)			
Change in Export Share at the Sector Level	-0.282 (0.008)**	-0.011 (0.002)**	0.013 (0.005)**	-0.252 (0.007)**	-0.010 (0.002)**	0.012 (0.005)**
Change in R and D share				-0.138 (0.061)*	0.396 (0.053)**	-0.215 (0.134)
Missing Trade	0.000 (0.001)	-0.006 (0.000)**	0.011 (0.007)	-0.000 (0.001)	-0.006 (0.000)**	0.008 (0.006)
R^2	0.17	0.00	0.00	0.17	0.00	0.00
N	1,277,591	7,133,021	2,018,466	1,422,482	7,144,743	2,026,997

Notes: All are first difference results. Time effects included in all specifications whose coefficients are not reported here. Labor share is defined at the establishment level as total renumeration divided by value-added. Research and development share is the share of expenditures divided by total revenues at the sector level. Trade shares are the share of exports in revenues at the sector level. Intangible and tangible assets are changes at the sector level in the share of tangible or intangible assets in total assets. RDSHARE, Trade share, tangible and intangible asset shares also exclude firm i. For establishment level regressions only, top 20 firms in terms of market share excluded.

Table 5. Labor Demand at the Firm and Sector Level

Dependent Variable:	Firm Level Results: Dependent Variable is First difference of the log of Employment				Sector Level Results			
	Change in the log of Employment at the Establishment Level				Change in the log of Employment at the Sector Level			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Change in CR4	-0.030 (0.002)**		-0.006 (0.001)**		-0.521 (0.156)**		-0.777 (0.162)**	
Change in share of tangible assets	0.005 (0.006)	0.007 (0.006)					0.028 (0.234)	-0.088 (0.233)
Change in share of intangible assets	0.075 (0.006)**	0.070 (0.006)**					-0.108 (0.234)	-0.152 (0.233)
Change in CR20		-0.033 (0.003)**		-0.008 (0.002)**		-0.868 (0.177)**		-1.207 (0.182)**
Change in Export share	0.035 (0.004)**	0.036 (0.004)**	0.029 (0.004)**	0.029 (0.004)**	1.476 (0.223)**	1.468 (0.222)**	1.683 (0.224)**	1.665 (0.223)**
Change in R and D share			-0.150 (0.083)	-0.141 (0.083)	-13.632 (2.663)**	-12.681 (2.668)**		
Missing Trade	-0.004 (0.000)**	-0.004 (0.000)**	-0.006 (0.000)**	-0.006 (0.000)**	-0.080 (0.075)	-0.036 (0.076)	-0.070 (0.075)	-0.010 (0.076)
R^2	0.00	0.00	0.00	0.00	0.78	0.79	0.78	0.79
N	10,652,349	10,652,349	11,659,816	11,659,816	2,176	2,176	2,176	2,176

Notes: First four columns at the establishment level and last four columns at the sector level. All specifications in differences and include time dummies whose coefficients are not reported here. Employment is the total number of employees at either the sector or establishment level. Research and development share is the share of expenditures divided by total revenues at the sector level. Trade shares are the share of exports in revenues at the sector level. Tangible and intangible asset shares in total assets, R and D shares, export shares, CR4 and CR20 all exclude firm i for the establishment level results in the first four columns.

Table 6. Labor Demand by Country at the Firm Level

Dependent Variable: Change in the log of Employment at the Establishment Level						
	Sweden	Sweden	France and Germany	France and Germany	South Korea and Hungary	South Korea and Hungary
Change in CR4	-0.057 (0.016)**	-0.055 (0.013)**	-0.009 (0.003)**	0.002 (0.001)	-0.053 (0.004)**	-0.053 (0.004)**
Change in share of tangible assets	-0.016 (0.014)		-0.050 (0.010)**		0.040 (0.010)**	
Change in share of intangible assets	0.016 (0.019)		0.007 (0.008)		0.098 (0.027)**	
Change in Export share	0.032 (0.018)	0.035 (0.016)*	0.022 (0.006)**	0.022 (0.006)**	0.071 (0.008)**	0.064 (0.008)**
Change in R and D share		-0.331 (0.118)**		-0.261 (0.199)		1.616 (0.317)**
Missing Trade	0.006 (0.002)**	0.006 (0.002)**	-0.016 (0.002)**	-0.015 (0.002)**	-0.026 (0.012)*	-0.007 (0.010)
R^2	0.00	0.00	0.00	0.00	0.00	0.00
N	2,912,666	3,603,840	5,224,244	5,282,477	2,515,439	2,773,499

Notes: All are first difference results. Time effects included in all specifications whose coefficients are not reported here. The log of employment is the log of the total number of employees at the establishment level. Research and development share is the share of expenditures divided by total revenues at the sector level. Trade shares are the share of exports in revenues at the sector level. Intangible and tangible assets are changes at the sector level in the share of tangible or intangible assets in total assets. RDSHARE, Trade share, tangible and intangible asset shares also exclude firm i. For establishment level regressions, top 20 firms in terms of market share excluded.

Table 7. Labor Demand at the Sector Level in Five Year Long Differences

Dependent Variable: Change in log of Employment				
	(1)	(2)	(3)	(4)
Change in CR4	-0.605 (0.179)**		-0.643 (0.177)**	
Change in share of tangible assets	-0.541 (0.282)	-0.489 (0.279)		
Change in share of intangible assets	0.079 (0.472)	0.392 (0.470)		
Change in CR20		-1.403 (0.220)**		-1.364 (0.215)**
Change in Export share	2.382 (0.257)**	2.436 (0.254)**	2.378 (0.255)**	2.422 (0.253)**
Change in R and D share			-13.167 (3.087)**	-12.304 (3.057)**
Missing Trade	-0.108 (0.048)*	-0.139 (0.048)**	-0.094 (0.048)	-0.125 (0.048)**
R^2	0.14	0.16	0.15	0.16
N	1,700	1,700	1,700	1,700

Notes: All four columns report long difference specifications and include year fixed effects. All variables are aggregated to the sector level. Employment at the sector level is the sum of all employees aggregated across establishments. Research and development share is the share of expenditures divided by total revenues at the sector level. Trade shares are the share of exports in revenues at the sector level. A * indicates significance at 5 percent and ** indicates significance at 1 percent level.

Table 8. Log Wages at the Firm and Sector Level

Dependent Variable:	Firm Level Results: Dependent Variable is First difference of the log of Wages Defined as Total compensation divided by Employment				Sector Level Results			
	Change in the log of Wages at the Establishment Level				Five Year Long Change in the log of Wages at the Sector Level			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Change in CR4	-0.087 (0.003)**		-0.109 (0.002)**		1.132 (0.163)**		1.228 (0.162)**	
Change in share of tangible assets	0.063 (0.008)**	0.077 (0.008)**			0.588 (0.253)*	0.542 (0.252)*		
Change in share of intangible assets	-0.044 (0.007)**	-0.187 (0.007)**			1.266 (0.423)**	1.072 (0.423)*		
Change in CR20		-0.009 (0.003)**		-0.090 (0.002)**		1.656 (0.199)**		1.753 (0.196)**
Change in Export share	-1.615 (0.005)**	-1.609 (0.005)**	-1.639 (0.005)**	-1.621 (0.005)**	-2.206 (0.230)**	-2.244 (0.229)**	-2.222 (0.231)**	-2.257 (0.229)**
Change in R and D share			-2.760 (0.116)**	-2.549 (0.116)**			5.194 (2.791)	3.628 (2.768)
Missing Trade	-0.025 (0.000)**	-0.025 (0.000)**	-0.029 (0.000)**	-0.030 (0.000)**	0.067 (0.044)	0.096 (0.044)*	0.058 (0.044)	0.091 (0.044)*
R^2	0.05	0.05	0.05	0.05	0.20	0.20	0.20	0.21
N	9,953,708	9,953,708	10,844,298	10,844,298	1,698	1,698	1,698	1,698

Notes: First four columns at the establishment level and last four columns at the sector level. All specifications in differences and include time dummies whose coefficients are not reported here. Employment is the total number of employees at either the sector or establishment level. Research and development share is the share of expenditures divided by total revenues at the sector level. Trade shares are the share of exports in revenues at the sector level. Tangible and intangible asset shares in total assets, R and D shares, export shares, CR4 and CR20 all exclude firm i for the establishment level results in the first four columns.

Table 9. Decomposing Establishment Level Changes in Labor Shares: Changes in Within-Firm Means Versus Reallocation Across Firms Between 2002 and 2019

		Germany (1)	France (2)	Hungary (3)	Korea (4)	Sweden (5)
2003–2008	Within-Firm	-2.89%	-0.07%	-0.16%	2.78%	7.75%
	Between-Firm	2.63%	1.35%	-1.44%	-1.78%	-4.06%
	Total Change	-0.26%	1.28%	-1.60%	1.00%	3.68%
2008–2013	Within-Firm	1.57%	0.34%	3.98%	1.40%	2.35%
	Between-Firm	0.13%	-1.76%	-1.98%	-2.18%	1.65%
	Total Change	1.70%	-1.42%	2.00%	-0.77%	4.00%
2014–2019	Within-Firm	0.53%	-1.88%	1.10%	-0.07%	0.14%
	Between-Firm	-0.27%	1.65%	-1.34%	0.26%	-1.19%
	Total Change	0.25%	-0.23%	-0.25%	0.19%	-1.05%
2002–2019	Within-Firm	-1.24%	-2.37%	5.76%	4.64%	9.65%
	Between-Firm	1.76%	-0.28%	-4.41%	-3.81%	-4.24%
	Total Change	0.53%	-2.65%	1.35%	0.83%	5.41%

Notes: All decompositions use the Olley-Pakes decomposition described in the text. Within-firm effects are the average change in the labor share in value-added within a sector. Between-firm changes are the reallocations across firms. The sum of the two is the total change in sector-level labor share.

Table 10. Sector Level Results with 2SLS: Annual Data and Five Year Differences

	Annual Data			Five Year Long Differences		
Dependent Variable:	Labor Share	Log Employment	Log Wage	Change in Labor Share	Change in Log Employment	Change in Log Wage
CR4	-0.150 (2.93)**	0.802 (2.40)*	-1.141 (3.67)**			
Sector Level Trade	-0.177 (1.85)	2.020 (4.07)**	-1.402 (3.32)**			
Sector Level R & D	-2.594 (2.80)**	-15.490 (2.80)**	-2.471 (0.50)			
Change in CR4				0.398 (0.285)	-3.101 (2.63)	3.573 (2.53)
Sector Level Trade				-0.285 (0.495)	15.738 (4.52)**	-13.302 (3.82)**
Sector Level R & D				2.039 (6.221)	-57.393 (26.17)**	27.931 (23.864)
First Stage F CR4	111.28	113.87	112.76	2.06	2.28	2.22
First Stage F R & D	19.35	18.30	18.43	2.44	2.11	2.11
First Stage F Trade Share	38.41	39.23	39.32	2.82	2.80	2.82
R^2	0.60	0.78	0.21	0.02	0.02	0.02
N	1,581	1,865	1,863	1,277	1,578	1,580

Notes: All estimates show two stage least squares estimation, where CR4, trade shares, and research and development shares are treated as endogenous. The instruments include the CR4, trade share, and research and development sectoral values for excluded countries. For France, the instruments are the sector level values for all other countries in the sample. The same for the other four countries in the sample. The first three columns include year, sector, and country effects. The last three columns are in long differences, as are the instruments. Only year effects are included in the last 3 columns. F-statistics for the first stage of each endogenous variable are also reported.

Appendix

Appendix Table A1. Sample ORBIS Coverage (Number of Observations and Percent of Total by Country) 1995–2019

IS Code (from BVD)	Number of Observations	Percentage of Total
DE	1,751,549	4.07
FR	26,648,120	61.97
HU	4,765,725	11.08
KR	4,465,769	10.38
SE	5,375,334	12.50
TOTAL	**43,005,061**	**100.00**

Appendix Table A2

BvD Major Sector	Number of Observations	Percentage of Total	Cumulative (%)
Banks	223,119	0.52	0.52
Chemicals, rubber, plastics, non-metal minerals	614,783	1.43	1.95
Construction	5,532,180	12.86	14.81
Education, Health	1,668,772	3.88	18.69
Food, beverages, tobacco	718,167	1.67	20.36
Gas, Water, Electricity	196,507	0.46	20.82
Hotels & Restaurants	2,479,291	5.77	26.58
Insurance Companies	6,146	0.01	26.60
Machinery, equipment, furniture, recycling	2,000,371	4.65	31.25
Metals & Metal Products	895,906	2.08	33.33
Other Services	14,739,171	34.27	67.61
Post & Telecommunications	99,983	0.23	67.84
Primary Sector	2,065,674	4.80	72.64
Public Administration & Defense	7,693	0.02	72.66
Publishing, Printing	744,928	1.73	74.39
Textiles, Wearing Apparel, Leather	357,561	0.83	75.22
Transport	1,383,542	3.22	78.44
Wholesale & Retail Trade	8,993,135	20.91	99.35
Wood, Cork, Paper	278,132	0.65	100.00
Total	**43,005,061**	**100.00**	

Appendix Table A3. Year Coverage

Year	Number of Observations	Percentage of Total	Cumulative (%)
1995	233,714	0.54	0.54
1996	413,539	0.96	1.51
1997	550,026	1.28	2.78
1998	720,128	1.67	4.46
1999	786,666	1.83	6.29
2000	857,929	1.99	8.28
2001	1,035,338	2.41	10.69
2002	1,149,457	2.67	13.36
2003	1,211,892	2.82	16.18
2004	1,410,594	3.28	19.46
2005	1,476,148	3.43	22.89
2006	1,377,334	3.20	26.10
2007	1,516,467	3.53	29.62
2008	1,635,298	3.80	33.43
2009	1,844,449	4.29	37.71
2010	1,866,812	4.34	42.06
2011	2,338,812	5.44	47.49
2012	2,488,374	5.79	53.28
2013	3,565,679	8.29	61.57
2014	3,910,423	9.09	70.66
2015	1,828,506	4.25	74.92
2016	3,789,477	8.81	83.73
2017	1,793,418	4.17	87.90
2018	3,083,737	7.17	95.07
2019	2,120,844	4.93	100.00
Total	**43,005,061**	**100.00**	

Appendix Table A4. Sectoral Means for Key Variables in 2002 and 2019

Variable Name	Sweden		France		Germany		Hungary		Korea	
	2002	2019	2002	2019	2002	2019	2002	2019	2002	2019
Labor Share in Value Added	0.58	0.64	0.75	0.67	0.61	0.64	0.70	0.70	0.44	0.44
Labor Share in Revenue	0.09	0.19	0.21	0.20	0.23	0.22	0.15	0.16	0.06	0.08
Four Firm Concentration Ratio (CR4)	0.45	0.35	0.43	0.42	0.45	0.40	0.43	0.34	0.31	0.25
Twenty Firm Concentration Ratio (CR20)	0.66	0.60	0.64	0.64	0.73	0.61	0.68	0.53	0.57	0.53
Intangible Assets as a Share of Total Assets	0.05	0.11	0.13	0.18	0.07	0.09	0.04	0.04	0.03	0.05
Tangible Assets as a Share of Total Assets	0.37	0.31	0.22	0.18	0.32	0.27	0.44	0.37	0.40	0.31
Export Shares in Sales	0.11	n.a.	0.17	0.06	n.a.	0.08	0.08	0.28	0.01	0.04
R & D as a Share of Sales	0.004	0.008	0.0019	0.0022	0.007	0.01	0.0002	0.0003	0.004	0.002