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DISENTANGLING VARIOUS EXPLANATIONS FOR THE DECLINING LABOR SHARE: EVIDENCE FROM MILLIONS OF FIRM RECORDS

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Abstract

This paper uses millions of records from a cross-country and time series database of both publicly listed and private companies to disentangle the role of technological change, intangible assets, market power, and globalization in driving a fall 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 with four distinct measures, including research and development expenditures, patent filings, and total factor productivity growth. Market power is measured using four firm and twenty firm concentration ratios and globalization is measured as export shares in total revenues. We also supplement the cross-country evidence with a more in depth look at Chinese companies using the China industrial census. The evidence suggests that between 1995 and 2019 important drivers of falling labor shares were market power and technological change, including intangible asset investments. The evidence on globalization is mixed. We also explore the determinants of labor demand. Labor demand is significantly and negatively associated with market concentration, but positively associated with most of our measures of technological change—for both the cross country and Chinese census data.

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

Ann Harrison

UC Berkeley, NBER[1], and CEPR

December 2024

Abstract: This paper uses millions of records from a cross-country and time series database of both publicly listed and private companies to disentangle the role of technological change, intangible assets, market power, and globalization in driving a fall 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 with four distinct measures, including research and development expenditures, patent filings, and total factor productivity growth. Market power is measured using four firm and twenty firm concentration ratios and globalization is measured as export shares in total revenues. We also supplement the cross-country evidence with a more in depth look at Chinese companies using the China industrial census. The evidence suggests that between 1995 and 2019 important drivers of falling labor shares were market power and technological change, including intangible asset investments. The evidence on globalization is mixed. We also explore the determinants of labor demand. Labor demand is significantly and negatively associated with market concentration, but positively associated with most of our measures of technological change—for both the cross country and Chinese census data.

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There will come a point where no job is needed. You can have a job if you want to have a job for personal satisfaction, but AI will be able to do everything.

Elon Musk, November 2023

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 Sahin (2013).[2] 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. 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.

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

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.

Relative to the United States, most other rich countries have had smaller increases in overall inequality due to more activist tax and transfer systems that mitigate the effects of declining labor shares. Another reason why the same economic factors might lead to different levels of income inequality across countries and regions has to do with institutions such as unions, and whether they are effective at protecting labor's interests. Card (1996, 1998, 2001) and others have documented the critical role of unions in holding up the bottom of the wage distribution, but data limitations prevent us from addressing this important consideration in our paper.

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 Oberfeld (2021) 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 using micro data across countries 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 explanations for declining labor shares in the economics literature: technological change, the rise in the importance of intangible asset investments, globalization, and market power. Figure 1 shows that the average labor share at the

company level—defined as total remuneration to employees divided by value added--declined significantly for more than half of the countries in our sample between 1995 and 2019. The declines are most evident for industrial countries, including many European countries and Japan. The decline was perhaps most dramatic for the United States, which shows a fall of 25 percentage points for publicly listed firms.

Many of the explanations for that decline have suggested that elements of technological change--such as labor-saving innovations or the increasing use of robots--are responsible for the decline in the US labor share (see, for example, Acemoglu and Restrepo (2020), Restrepo (2023)). 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. 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.

Figure 2 shows that in the United States, expenditures on research and development as a share of company revenues have increased in every single sector. 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 rising share of intangible assets in total assets consequently constitutes a second popular explanation for the falling labor share, at least for the United States. While intangible asset investments could be thought as a pathway for technology to affect returns to labor, the mechanisms proposed are often different. Loh et al (2020) emphasize the mismeasurement 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 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.

Much of the US 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.

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 Sahin (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 skill sets and for importing versus exporting sectors.

A fourth popular explanation for falling labor shares in the United States is increasing market power, associated with the rise of superstar firms. Figure 3, using the ORBIS data which covers all public companies in the United States, shows that the market share of the top four or top twenty companies in most sectors increased between 1995 and 2019. The rising concentration of business activity (at least for publicly listed companies covered by Orbis) is particularly clear for

manufacturing but has occurred in other sectors as well, including in services sectors like health care and insurance. The most prominent of published studies focusing on market power explanations is Autor, Dorn, Katz, Patterson and Van Reenen (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 even more pronounced for countries like the United States, Great Britain, and Japan, indicating a reallocation of the labor force towards companies with low labor shares.

For the United States, the fall in the labor share is so dramatic for publicly listed companies that it warrants further investigation. Figure 5 shows both the unweighted labor share in value added from Figure 1 for the United States and traces the evolution of profit shares and remuneration in revenues. Figure 5 shows how labor shares in value added could fall so dramatically in the United States. Between 1997 and 2019, profits as measured by EBITDA/revenue doubled, climbing from 8 to

16 percent for listed companies in the Orbis database. While revenue increased, labor compensation did not climb as quickly. Consequently, labor compensation shares in revenues fell from 28 to 12 percent. The ratio of labor compensation to profits flipped--falling from 80 to 40 percent as a result. For further corroboration, Appendix A.4 shows a similar pattern for one of the largest companies in the United States—Amazon. Appendix A.4 also shows the pattern for Walmart. For Amazon, the labor share in value added fell by half and profits doubled. While Walmart's labor share did not decline, Walmart's labor share in value added was miniscule to begin with—rising from less than 2 to almost 4 percent of value added. One implication is that overall labor share in the United States could fall as aggregate employment shifts from high labor share (like United Airlines) to low labor share (like Walmart) companies.

This paper takes an agnostic view and uses a comprehensive Orbis dataset of millions of observations that spans three decades and 43 countries to measure the importance of each of these four leading explanations in a consistent framework. Orbis covers both listed and unlisted companies, with coverage varying across countries. For the United States, all listed companies are included, which means coverage accounts for 8,000 of some of the largest companies. 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-Ozcan, Sorensen, Villegas-Sanchez, Volosovych, and Yesiltas (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 and Kalemli-Ozcan (2017) as well as Gourinchas and Kalemli-Ozcan (2020).

One shortcoming of the Orbis database is that its coverage for many emerging markets is inadequate. To compensate for this shortcoming, we also report results for China using their census of manufactures for the period 1998 through 2007. An additional advantage of adding Chinese census data to the analysis is that it allows us to explore alternative measures of technological change, such as patent filings and total factor productivity growth. To be consistent with the Orbis data, labor's share is again defined as the share of total compensation in value added. Another recent study, Yang and Tsou (2021), also explores the determinants of the labor share in China. They find that the firm level labor share is negatively associated with total factor productivity as a measure of technology and positively associated with export activity. They find similar results using alternative technology measures, such as product innovation and research and development expenditures. However, they do not explore the role of market power.

Orbis provides a consistent lens over time regarding company level investments in technology, their experience with globalization, investments in both tangible and intangible assets, and proxies for market power. Based on available accounting data as reported by Orbis, investment in technology is measured as the ratio of research and development expenditures to total sales. It is difficult to disentangle technology investments from other types of investments, so we also include investments in tangible assets, which include investments in machinery and equipment. Intangible asset investments capture investments in software and other non physical investments. Globalization is measured using a standard trade share: the share of export revenues in total sales. Market power is

measured in the same way as Autor et al (2020): the 4 or 20 firm concentration ratio (CR4 or CR20) in a specific type of industry and country and year.

Grossman and Oberfeld (2020) are concerned about the lack of identification in many studies of the labor share, emphasizing in particular the challenges associated with cross sectional studies. Through the use of a time series 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.

As is evident from studies of productivity growth, there is no reason why the sector and establishment level results need to be the same. If there are dramatic changes in market share over time, with the largest firms characterized by lower labor shares and growing over time, the impact of market power could be magnified in the sector data. Or the reverse could be true: if smaller firms with higher labor shares become more prominent over time, then the impact of market power at the sector level could be lower. We begin the analysis with the sector level results, in keeping with most recent studies. Aggregating the firm-level data to the sector level in the Orbis data—keeping only those countries with at least 100,000 observations—suggests that all four explanations are supported by the data. Technology measured using research and development expenditures, intangible asset investments, globalization, and market power all significantly and negatively affect the labor share. All four have contributed to labor share declines. Coefficient estimates are largest and most negative for research and development, intangible asset investments and market concentration. A one percentage point increase in the intangible asset share in total assets or a one percentage point increase

in the four firm concentration ratio is associated with a labor share reduction of 0.17 (for intangibles) and 0.14 (for concentration).

The story for China is different. Industrial countries are over-represented in the Orbis dataset, and consequently the Orbis results can best be interpreted as revealing of industrial country experience—particularly European industrial country experience. 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 China, we would consequently expect that globalization should increase the return to labor (presumably if China has a comparative advantage in producing labor-intensive goods) and lower the return to capital. The results for Chinese census data during the 1998 through 2007 period reveal that higher labor shares at the firm level are associated with higher trade exposure. Our firm level results are consistent with Yang and Tsou (2021).

These two different datasets—the Orbis data which tracks millions of firms across countries and the Chinese census data—reveal a consistent pattern. The most important factors associated with falling labor shares are proxies for technological change, intangible asset investments and market power. While market power is significantly associated with declines in labor shares both across the world and for China itself, the role of globalization is much more nuanced. While globalization may be associated with declining labor shares in countries like the US, that same globalization (as measured by firm-level export activity) has been associated with significant gains for labor in China.

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. In this paper, we also explore how the four leading explanations for labor share declines are associated with establishment level and sector level employment. The results are consistent across both our Orbis samples and China's industrial census. Most measures of technological change—including patent filings, intangible asset investments, and tangible asset investments—are positively and significantly associated with employment at the establishment and sector level, suggesting that the productivity effects dominate the labor displacing effects. The only factor out of the four explanations that is 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. Market power is significantly associated with declining labor shares and declining employment in both the establishment and 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 affect labor's share. Section II describes the Orbis data and presents the results on labor shares and employment at both the firm and sector level. Section III presents the results for China 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 (1996), who argue that rising labor demand elasticities could shift the incidence of nonwage 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 (2001), 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 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 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:

(1a) $U_L = (w_L - w_{L0})v_L$ *(1b)* $U_K = (w_K - w_{K0})v_K$

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

(2) G(**P(Y(v)), v**) - $\mathbf{w_0 v}$

Maximizing (2) with respect to **v** yields the following first order condition:

$$[\boldsymbol{\partial Y/\partial v}]\boldsymbol{P} = \mu \boldsymbol{w_0}$$

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

$$\mathbf{v^* = R(P,\mu,w_0)}$$

The excess rents given by (2) can be written as:

(4) Rents =G(**R**) - $\mathbf{w_0 R}$

Thus, total revenue, G(**R**), factor demands, **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:

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

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 $Fi = f_i v_i$. Consequently, we can write the threat points as:

(5a) $U_{L0} = w^*_L v_L - f_L v_L$

(5b) $U_{K0} = w^*_K v_K - f_K v_K$

So our maximization problem becomes

(6) Maximize $\{w_L v_L - w^*_L v_L + f_L v_L\}\{w_K v_K - w^*_K v_K + f_K v_K\}$

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):

(7) $v_L(w_K v_K - w^*_K v_K + f_K v_K) = \lambda$

(8) $v_K(w_L v_L - w^*_L v_L + f_L v_L) = \lambda$

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

(9)

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

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 of (9) by $G(R)$ yields the following expression for the labor share S_L:

(10)

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

We can think of the alternative vector **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:

(11)

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

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.[3]

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 **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:

$$(12) \qquad \frac{\alpha}{\mu} = \frac{w_{0L} v_L}{PY}$$

The Autor et al (2020) framework assumes no bargaining and a perfectly competitive labor market. 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

[3] 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 (2001) 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 (2001), 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.

power and retain all the surplus in a bargaining game, and where the labor market is competitive, 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. This model makes it clear that with imperfect competition and wage bargaining, 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 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 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.

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 countries with at least 100,000 observations. This reduces the sample size of firm-year observations to slightly over 139 million records (see Appendix Table A1). The distribution across countries is reported in Appendix Table A1. It is evident from the Table that the countries with the largest number of observations are typically European countries. France tops the list, with 19 percent of the total establishment-year observations, while coverage is also high for Spain, Great Britain, Italy, Canada, and Belgium. Several Asian countries are also well represented, including Japan, South Korea, and Vietnam. Notably poorly represented is the United States, with only 160,000 observations in total representing listed companies, however these are typically the largest listed companies such as Amazon, Apple, and Walmart.

Appendix Tables A2 and A3 show the breakdown by year and by sector. The years with the highest representation are 2006 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 or employment 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:

$$(13\,a)\quad LABOR_{cjt} = B_1 TECH_{cjt} + B_2 CONC4_{cjt} + B_3 INTANG_{cjt} + B_4 TRADE_{cjt} + f_c + s_j + D_t$$

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

$$(13b)\ \Delta LABOR_{cjt} = B_1 \Delta TECH_{cjt} + B_2 \Delta CONC4_{cjt} + B_3 \Delta INTANG_{cjt} + B_4 \Delta TRADE_{cjt} + D_t$$

The dependent variable is either labor share or the log of employment. 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 139 million establishment-year million for our chosen sample period and countries (Appendix Tables A1 and A2) to 42 million. Coverage for numbers of employees is much more extensive (we report results for 59 million observations later in the paper) and includes "total number of employees included in the company's payroll" according to the formal Orbis data definition. 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. Since only 12 out of the 43 countries report export revenues, we include a dummy variable for missing values for those cases where no data is available. Results for globalization are not affected by this inclusion, and

point estimates are consistent for all 43 (including a dummy for missing data) as well as estimation over a smaller subset of all 12 countries with non missing export data. 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.

Autor et al (2020) present a model and results for US firms showing that reallocation and not average firm changes in labor shares have driven the fall in labor shares. This phenomenon will not show up in firm-level changes but at the sector level. However, for completeness we will also report firm level results below. 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.

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 -0.142 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 1.42 percentage point. The coefficient on research and development expenditures varies from -0.72 to -0.73. 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 0.72 to 0.73. While the magnitude is largest for research and development, the coefficient on intangible assets is also large and negative. The coefficient, at -0.18, indicates that an increase in intangible asset shares of 10 percentage points would be associated with a labor share decline of 1.8 percentage points. Tangible assets are also negatively and significantly associated with labor share

reductions, but the magnitude is one third of the intangible asset value. The coefficient on sectoral trade, which varies between -0.08 and -0.14, indicates that a 10 percentage point increase in the share of exports in revenues would reduce the labor share by 0.8 go 1.4 percent. The coefficients on the two concentration ratios are of similar magnitude, between -0.14 (for CR4) to -0.17 (for CR20), with similar impacts on labor shares.

In keeping with the Autor et al (2020) approach, we also extend the analysis and transform the data into 10 year long differences. Since we are taking 10 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 are systematically and negatively associated with sector level labor shares over ten years. The point estimates, which range from -0.12 to -0.15 are consistent with the annual year to year panel presented in Table 1 as well as with the Autor et al (2020) results.

What about the other drivers of the labor share? The association with both intangible and intangible changes in the share of assets are also significant and negative for the ten year differences. In comparison to the association with concentration, investments in intangible assets are roughly twice as large in terms of their negative relationship with labor shares. In contrast, the relationship with research and development expenditures is not significant in the long differences. As we discussed earlier, only a small minority of companies globally report positive research and development expenditures, making it difficult to assess the accuracy of this relationship. For trade, the relationship is negative and s significant in the long year differences, of slightly smaller magnitudes relative to concentration.

Autor et al (2020) find that the majority of changes in labor shares occur through reallocation

of market share to larger enterprises. This means that most of the action in driving labor shares can be understood by analyzing the determinants of sector level labor shares. However, it is still instructive to explore the determinants of enterprise level labor shares, particularly for those firms where much of the change in labor shares occurs within the same enterprise.

Exploring enterprise level labor share determinants are also important for another reason. One concern raised by Grossman and Oberfeld (2021) is the over reliance 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:

$$SectorRandD_{ijt} = \frac{\sum_{k\neq i}^{n}\left(researchdevelopmentexpenses_{kjt}\right)}{\sum_{k\neq i}^{n}\left(total\ revenue_{kjt}\right)}$$

We graph both this firm-specific measure as well as the mean in Figure 6. While the firm-specific

measure follows the overall trend in the ratio of research and development to total revenue as reported in Figure 6, 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 do the same for sectoral trade shares. We have the sectoral trade share for firm i in sector j at time t defined as:

$$SectorTradeshare_{ijt} = \frac{\sum_{k \neq i}^{n} (exportrevenue_{kjt})}{\sum_{k \neq i}^{n} (total\ revenue_{kjt})}$$

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 all independent variables while the last two columns exclude trade and research and development expenditures due to their reduced coverage. In the first two columns, market power as proxied by CR4 and CR20 (the 4 and 20 firm concentration ratios) 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 10. 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 also larger than for the sector level results. A 1 percentage point increase in export shares is associated with a 0.17 percentage point decline in the labor share. For research and development, a one percentage point increase is associated with a 0.25 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. Using a very different dataset, which covers many countries over the 1995 through 2019 period, the results are remarkably consistent with those presented in Autor et al (2020). The point estimates at the sector level indicate that a 10 percentage point increase in concentration is associated with a fall in the labor share of between 1 and 1.5 percent. The magnitudes again are consistent with Autor et al (2020), but the results also indicate that other factors matter as well—particularly investments in technology. Investments in technology—particularly intangibles such as patents or trademarks or research and development expenditures—are associated with even larger declines in labor share at the sector level as well as at the establishment level. Globalization's impacts are also significant and negative for both the sector-level and establishment level results.

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 4.

The first row of Table 4 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 up to a two percentage point decline (2.2 for CR20) in employment. The impact is smaller at the establishment level by a factor of 100, indicating that most of the result is due to reallocation of employment towards more highly concentrated establishments.

While sectoral concentration is unambiguously associated with lower employment at both the establishment and sector level, the opposite is true for investments in tangible and intangible assets. At both the firm and sector level, changes in the share of assets in intangibles and tangibles are associated with an increase in employment. The magnitudes are nearly double for intangibles, which contrasts with their more negative association with labor shares in earlier tables. The association is greatest at the sectoral level. At the sector level, a 1 percentage point increase in the share of intangible or tangible assets in total assets is associated with an increase in employment of between .4 and 1.8 percent.

While concentration is unambiguously associated with lower labor demand and asset investments are associated with positive labor demand, the results for trade and research and development are mixed. Sectoral trade shares are associated with negative and small employment effects at the firm level but positive employment outcomes (but insignificant) at the sector level. 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 a 1.3 to 1.4 percentage point decline in employment at the sector level.

Table 5 repeats the analysis at the sector level, for five year long differences. The results are very similar to the previous table. Tangible and intangible assets positively affect employment and are statistically significant. The largest and most negative association is with market concentration, where a one percentage point increase is associated with more than a two percentage point decline in employment. As with the establishment and annual sector level results, research and development expenditures are negatively associated with employment. Only one variable changes sign, which is export shares. Export shares are positively and significantly associated with employment growth. The magnitude is large: a 1 percent increase export shares is associated with a 0.5 percent increase in employment. The export results are robust to different extensions as well, such as restricting the sample to only countries with export data.

The results in Tables 4 and 5 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 becomes positive in the long differences. One implication of the results in Table 5 are that employment outcomes are positively associated with less concentrated market structures and investments in both intangible and tangible assets, as well as with trade over the longer term. These results will be reinforced by the in depth case study on China, which we present below.

III. Estimation Results: Chinese Census Data

One shortcoming of the ORBIS dataset is its limited coverage for two economic giants: the United States and China. In this section, we use manufacturing census data for 1998 through 2007 to explore the determinants of labor shares in China. The dataset, collected by the Chinese National Bureau of Statistics, is described in greater detail in Du, Harrison, and Jefferson (2012, 2014). We retain only the manufacturing enterprises and eliminate establishments with missing values or negative or zero values for key variables such as output, employees, capital, and inputs. The years covered include 1998 through 2007. This is a true panel, following the same firms over time. We dropped three sectors with incomplete information on prices from the sample. The final sample size is 1,545,626 observations. The dataset contains information on real and nominal output, assets, number of workers, renumeration, inputs, public ownership, foreign investment, sales revenue, and exports.

To be consistent with Section II, we define labor shares, concentration ratios and globalization exactly as with ORBIS. Average labor shares for the sample period, defined as total compensation to employees divided by value added, are shown declining over the period 1998 through 2007 in Figure 7. Again, we exclude the firm's own export revenues in defining globalization as export revenues divided by total revenues. We also define concentration at the four and twenty firm level the same way, excluding those top four and top twenty firms from the sample in order to minimize endogeneity bias. One challenge is that research and development expenditures during the sample period are only reported for the last years of the sample. In order to be able to span the period before and after China's accession to the WTO, we shift to a different measure of technology, total factor productivity.

The standard approach to measuring firm-level performance is to identify total factor productivity (TFP) levels or growth. Since TFP is an overall efficiency parameter, it is best understood as measuring process innovation—the cost reduction associated with improving the efficiency in producing an existing product. Another measure of innovation is product innovation—associated with the introduction of new products or higher quality goods. Our primary focus is on process innovation, since product innovation is not reliably measured and was also less pervasive for firms in the sample during this period. Our total factor productivity measure is calculated in two different ways—first using OLS and firm fixed effects to derive coefficients on inputs before calculating TFP—and second using the Olley-Pakes method. For more details, please see Aghion, Cai, Dewatripont, Du, Harrison, and Legros (2015).

Results are reported in Table 6. All specifications are at the establishment level, and all variables are in first differences. In column (1) the coefficient on CR4 of -0.08 indicates that a 10 percent increase in concentration would reduce the labor share at the enterprise level by 0.8 percentage points. Labor share is defined as total compensation to all labor divided by value-added, which is consistent with the definition we use for the ORBIS dataset. The coefficient of -0.08 is not much different than the coefficients reported using the ORBIS data. The coefficient on export shares at the sector level (excluding the firm's own share) is quite different, however. For China, the coefficient on trade switches in sign to positive and significant. The estimate, which is 0.189 in the first column, indicates that a ten percentage point increase in the share of exports in revenue would be associated with a 1.89 percentage point increase in the labor share. Our two different measures of changes in total factor productivity (TFP) are reported in columns (1) and (2). Column (1) reports the impact of changes in TFP calculated using OLS and fixed effects to recover production function

parameters needed for calculating TFP. The coefficient, -0.234, indicates that if TFP growth were to grow by five percentage points then this would lead to a 1 percent decline in labor's share.

Column (2) replaces the change in CR4 with the change in CR20. The results are similar, with the coefficient on CR20 almost exactly the same. The coefficient on trade shares also remains the same, as is the coefficient on TFP. Generally, the results are similar when using CR4 as a measure of concentration versus CR20. In columns (3) and (4) we replace the TFP measure with a TFP measure derived using a standard Olley-Pakes approach. The OP approach allows for the endogeneity of factor shares as well as entry and exit in calculating input coefficients.

The coefficients remain stable in columns (3) and (4) with the alternative measure of the change in TFP. The coefficient on TFP remains at -0.23, while the coefficient on trade shares decreases slightly. The coefficient on the two concentration measures becomes more negative, moving from -0.08 to -0.15, indicating a larger negative impact of concentration on labor shares and consistent with the sector-level results for the global ORBIS data presented in earlier tables. The coefficient of -0.15 indicates that a 10 percent increase in concentration would reduce labor's share in value added by 1.5 percentage points.

One question that frequently arises is how to measure market power. Four firm concentration ratios, while frequently used as a measure of market power, are not exactly correct. Concentration ratios measure the concentration of market structure, while markups would be a measure of actual collusive behavior. Another question that often arises is how to measure the scope of a particular market. To allow for the exercise of market power at the region level but not necessarily at the sector level (think of a "one company town") we also constructed alternative measures of market concentration at the region level.

County concentration levels have a similar, but more muted impact. At the region level, county concentration is negatively related with labor share. We also explore extensions to this basic specification in Appendix Table A.5 In the appendix we replace TFP as a measure of technical change with patent counts. Using patent counts leads to very similar results as TFP. In both levels and five year long differences, increases in patent counts at the firm level are associated with significantly lower labor shares. In the last two columns of Appendix Tabel A.5, we show that adding controls for the log of the capital stock does not change the results.

The Chinese establishment data show a consistent pattern compared to the global ORBIS results, particularly the ORBIS results at the sector level. Concentration is significantly and negatively associated with labor shares, and the point estimates are similar in magnitude to the sector-level ORBIS results. Technical change, measured using total factor productivity growth instead of investments in tangibles and intangibles, shows a negative association with labor share as well. Export shares are consistently positively associated with labor shares, which is not inconsistent with the mixed association between labor shares and trade shares in the ORBIS data.

The results from the ORBIS data indicate that investments in tangible and intangible capital are associated with a fall in the labor share but an increase in employment at the establishment and sector level. In Table 7, we explore the establishment level determinants of employment for China. We present long differences for five year intervals, which reduces the sample size. Measures of technology investments include both changes in intangible and tangible asset shares as well as patents. Patents are measured two ways: the five year change in the number of patent filings, and the change in a zero-one measure indicating whether or not any patents have been filed.

The results show a strong positive association between innovation as measured by changes in

number of patents filed and employment growth at the establishment level. These results are unaffected by whether patents are measured in total patent counts or a zero-one indicator variable. The results are also robust to the inclusion of the change in capital stock at the establishment level, which is also positively and significantly associated with employment growth. In contrast, and in keeping with the ORBIS results, increasing concentration is negatively and significantly associated with employment. The point estimate on the four firm concentration ratio, which ranges from -0.27 to -0.34, indicates that a 1 percentage point increase in CR4 is associated with a fall in employment of 0.3 percent. Trade shares are positively and significantly associated with employment growth.

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 43 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, intangible asset investments, and market power. If we measure technical change either using firm-level research and development shares in sales or by deriving multifactor productivity (TFP) changes, we find that technology has a significant negative impact on labor shares but a positive impact on employment. A 1 percentage point increase in

research and development expenditures as a share of revenues is associated with a 0.7 percentage point decline in labor's share. Intangible asset investments as a share of total assets, which increased by five percentage points in the US listed company records, are also important. A 1 percentage point increase in intangible asset shares is associated with a 0.18 reduction in the labor share.

Market power, as measured by four or twenty firm concentration ratios is associated with a decline in labor's share as well as 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. Using the Orbis data, the impact of globalization as measured by export shares in enterprise revenues has a similar impact. We also complement these results with an in depth look at China for the 1998 through 2007 period, as China (and the United States) are not well covered by Orbis. For China, the results are similar in sign and magnitude for technology and market power. However, in China an increase in export shares is associated with rising labor shares and employment, indicating a very different and positive effect of trade.

One implication of these results is that efforts to impose protectionist measures could have a smaller impact on labor shares relative to encouraging less concentration or promoting technological change in the direction of labor-using rather than labor-reducing technology. 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 China also points to the likely benefits of globalization for returns to labor in emerging 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. For China, patent activity is also associated with labor share declines but employment growth, suggesting that the productivity enhancing impact of technological change has outweighed the displacement effect. Only one driver is clearly associated with both labor share declines as well as employment declines: market power. Rising concentration, as documented in the US Orbis data, is associated with unambiguous declines in both labor shares and employment. The magnitudes are large: a 1 percent increase in 4 firm concentration ratios is associated with more than a 2 percentage point reduction in employment.

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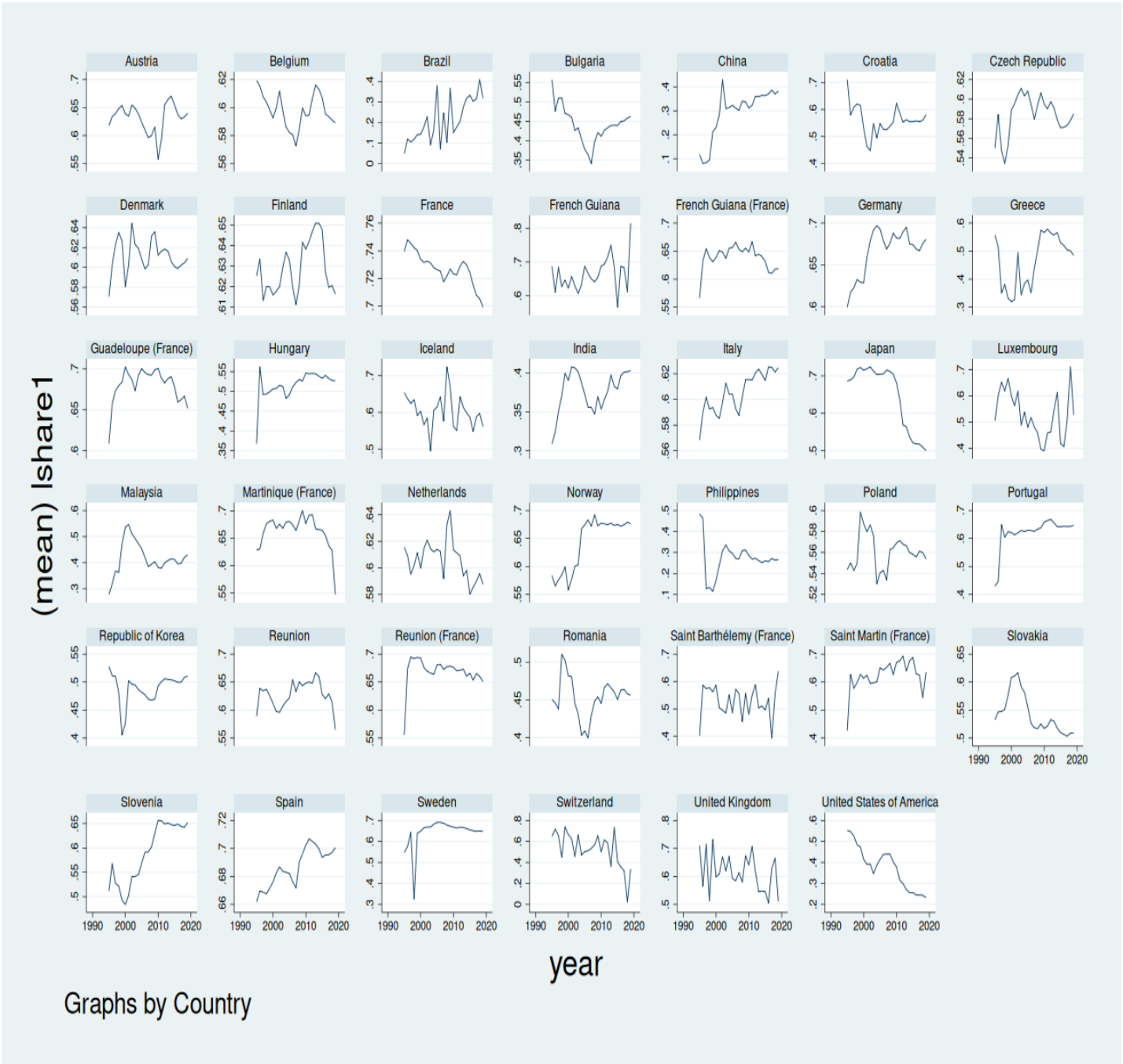


Figure 1: Labor Shares in Orbis as a share of value added: Unweighted Means

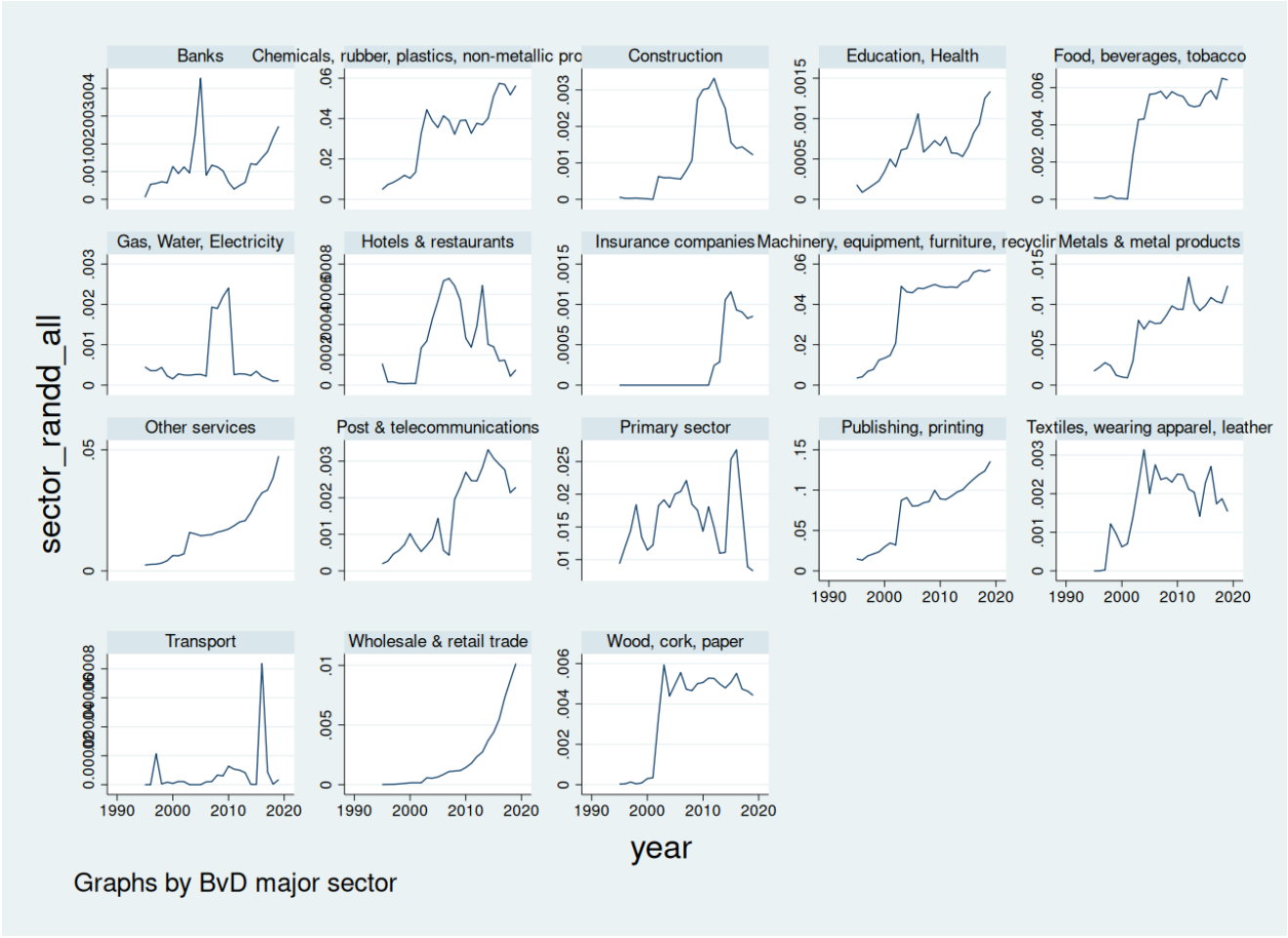


Figure 2

Share of Research and Development Expenditures in Revenues in the United States, by Sector (Orbis Dataset)

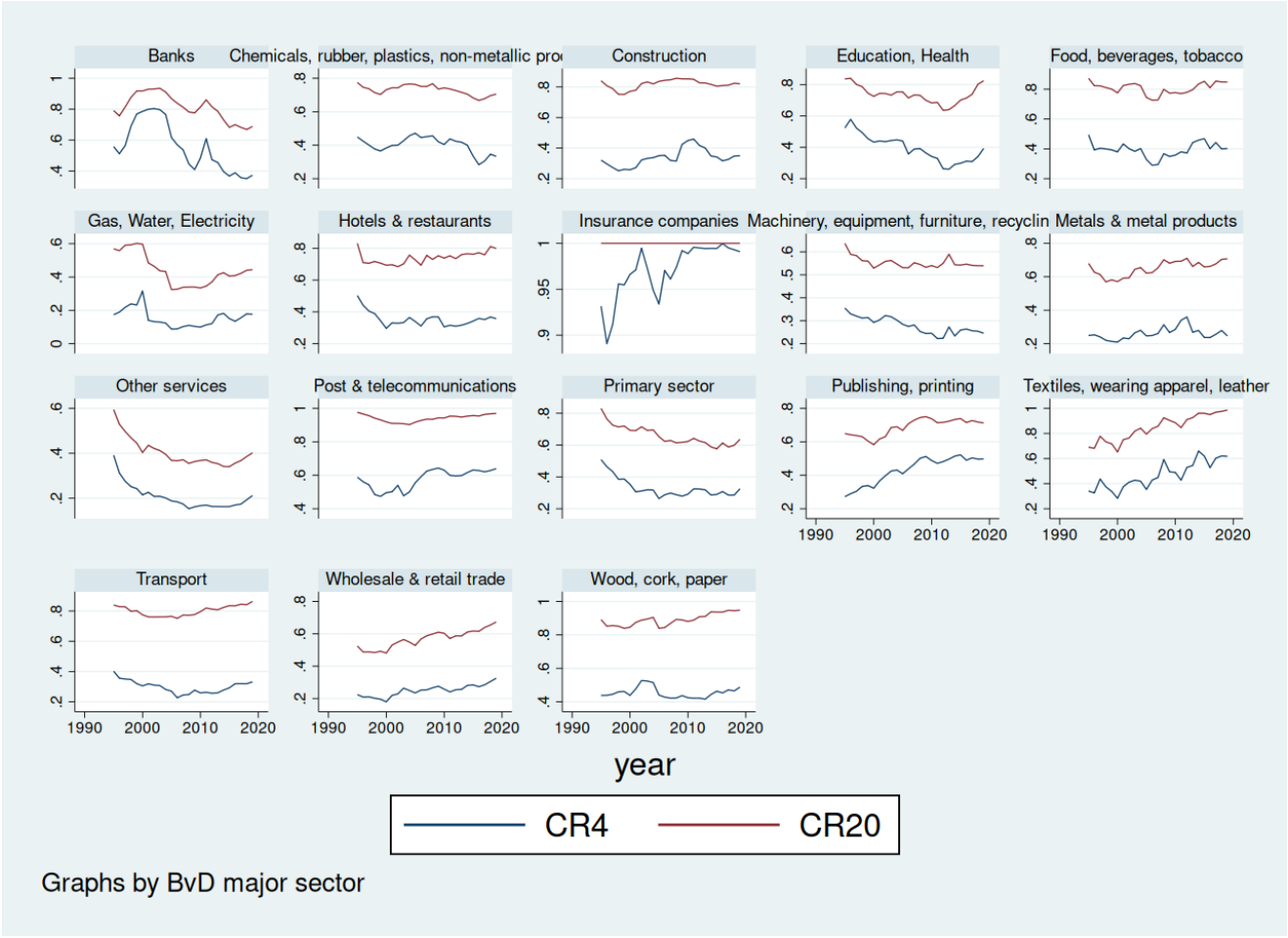


Figure 3

CR4 and CR20 Measures of Market Concentration in the United States, by Sector (Orbis Dataset)

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

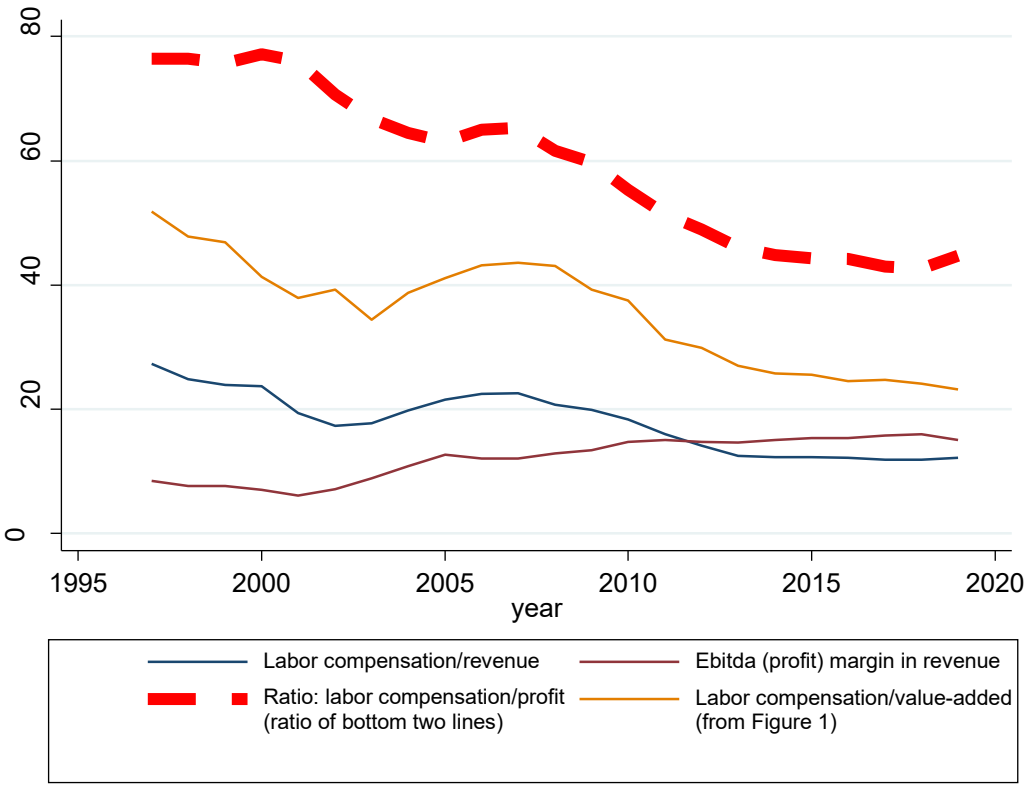


Figure 5
The Great Slide: United States Only
Key Ratios from Orbis Data

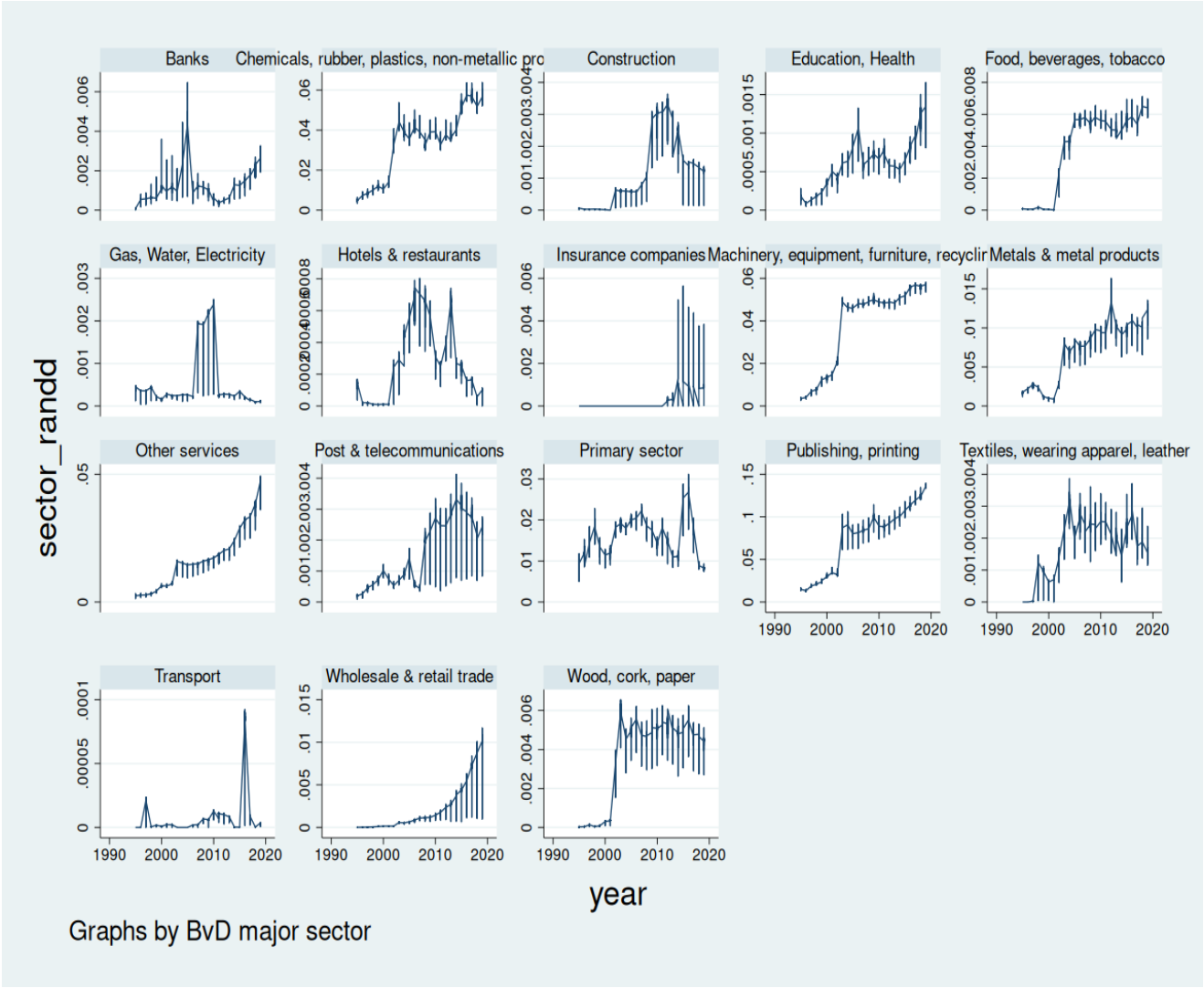


Figure 6

Research and Development Expenditures as a Share of Revenue, Excluding each Firm's own R and D and Sales measures, by Sector

(Orbis Dataset)

Figure 7
Mean Unweighted Total Compensation as a Share of Value-Added in China: Industrial Census for 1998 through 2007

Table 1: Sector-Level Results

Dependent Variable:	Labor Share	Labor Share	Labor Share	Labor Share
CR4 (Four firm Concentration ratio)	-0.142 (0.008)**		-0.151 (0.008)**	
Sector level share of Tangible assets in Total assets	-0.049 (0.013)**	-0.058 (0.013)**		
Sector level share of Intangible assets in total assets	-0.178 (0.024)**	-0.176 (0.024)**		
Share of research And development expenditures in total sales at the sector level			-0.727 (0.142)**	-0.723 (0.142)**
Share of exports In sales at the sector level	-0.079 (0.031)*	-0.086 (0.031)**	-0.142 (0.031)*	-0.077 (0.031)*
CR20		-0.160 (0.009)**		-0.169 (0.009)**
Constant term	0.916 (0.025)**	0.955 (0.025)**	0.828 (0.025)**	0.866 (0.026)**
R2	0.49	0.49	0.49	0.49
N	12,712	12,712	12,716	12,716

All four columns report levels specifications which include sector fixed effects, year fixed effects, and country fixed effects, as well as a dummy variable equal to 1 if trade information is missing for the country. All variables 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 1 percent.

Table 2: Long Differences at the Sector Level: Determinants of Labor Shares

	Ten Year Differences			
	Change in Labor Share	Change in Labor Share	Change in Labor Share	Change in Labor Share
Change in CR4	-0.118 (0.012)**		-0.130 (0.012)**	
Change in R and D Share			-0.073 (0.186)	-0.104 (0.186)
Change in Export share	-0.122 (0.045)**	-0.133 (0.045)**	-0.109 (0.045)*	-0.119 (0.045)**
Change in Share of tangible assets	-0.085 (0.020)**	-0.091 (0.020)**		
Change in Share of intangible assets	-0.192 (0.034)**	-0.190 (0.034)**		
Change in CR20		-0.141 (0.014)**		-0.154 (0.014)**
Constant term	-0.028 (0.011)**	-0.029 (0.011)**	-0.028 (0.011)**	-0.029 (0.011)**
R^2	0.04	0.04	0.03	0.03
N	6,075	6,075	6,078	6,078

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 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. A * indicates significance at 5 percent ** indicates significance at 1 percent level.

Table 3: Firm Level Determinants of the Labor Share

Dependent Variable:	Change in Labor Share	Change in Labor Share	Change in Labor Share	Change in Labor Share
Change in CR4	-0.015		-0.010	
	(0.000)**		(0.000)**	
Change in share of	0.012	0.012		
Intangible assets	(0.001)**	(0.001)**		
At the Sector Level				
Change in share	0.025	0.014		
Of tangible assets	(0.001)**	(0.001)**		
At the Sector Level				
Change in CR20		-0.009		-0.006
		(0.001)**		(0.000)**
Change in	-0.155	-0.152	-0.169	-0.166
Export Share	(0.001)**	(0.001)**	(0.001)**	(0.001)**
At the Sector Level				
Change in			-0.258	-0.247
R and D Share			(0.024)**	(0.024)**
At the Sector Level				
R^2	0.00	0.00	0.00	0.00
N	30,883,124	30,883,124	31,660,107	31,660,107

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: Labor Demand at the Firm and Sector Level

	Firm Level Results: Dependent Variable is First difference of the log of Employment				Sector Level Results			
Dependent Variable:	Change in the log of Employment at the Establishment Level				Change in the log of Employment at the Sector Level			
Change in CR4	-0.022		-0.041		-2.015		-2.054	
	(0.001)**		(0.001)**		(0.056)**		(0.056)**	
Change in share of tangible assets	0.039	0.041			1.202	1.142		
	(0.003)**	(0.003)**			(0.085)**	(0.085)**		
Change in share Of intangible assets	0.077	0.078			1.754	1.752		
	(0.002)**	(0.002)**			(0.161)**	(0.162)**		
Change in CR20		-0.027		-0.046		-2.268		-2.217
		(0.001)**		(0.001)**		(0.064)**		(0.064)**
Change in Export share	-0.008	-0.007	-0.002	-0.001	0.215	0.256	0.151	0.194
	(0.002)**	(0.002)**	(0.002)	(0.002)	(0.157)	(0.157)	(0.159)	(0.160)
Change In R and D share			-0.235	-0.221			-1.311	-1.449
			(0.047)**	(0.047)**			(0.237)**	(0.238)**
Constant term	0.016	0.016	0.016	0.016	4.846	5.149	4.846	5.149
	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.179)**	(0.183)**	(0.179)**	(0.183)**
R^2	0.00	0.00	0.00	0.00	0.73	0.72	0.73	0.72
N	53,788,100	53,788,100	58,860,706	58,860,706	17,317	17,317	17,317	17,317

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 5: Labor Demand at the Sector Level in Long Differences

	All Specifications are Five year long Differences			
Dependent Variable:	Change in log of Employment			
Change in CR4	-1.883		-1.950	
	(0.061)**		(0.061)**	
Change in share	0.746	0.795		
of tangible assets	(0.093)**	(0.093)**		
Change in share	0.513	0.420		
Of intangible assets	(0.168)**	(0.168)*		
Change in CR20		-2.236		-2.269
		(0.075)**		(0.075)**
Change in	0.496	0.525	0.462	0.495
Export share	(0.173)**	(0.173)**	(0.175)**	(0.176)**
Change			-0.754	-0.805
In R and D share			(0.188)**	(0.188)**
Constant term	0.239	0.238	0.232	0.230
	(0.051)**	(0.051)**	(0.052)**	(0.052)**
R^2	0.15	0.14	0.14	0.14
N	13,234	13,234	13,285	13,285

Notes: All specifications in differences and include time dummies whose coefficients are not reported here. Employment is the total number of employees at the sector 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.

Table 6: Chinese Labor Share Regressions, 1998-2007
All Specifications are in First Differences

	Change in Labor Share	Change in Labor Share	Change in Labor Share	Change in Labor Share
Change in CR4	-0.080 (0.006)**		-0.150 (0.006)**	
Change in CR4 at county level	-0.016 (0.004)**		-0.014 (0.004)**	
Change in Trade Share	0.189 (0.004)**	0.188 (0.004)**	0.177 (0.004)**	0.178 (0.004)**
Change in TFP Calculated with OLS first stage	-0.234 (0.001)**	-0.235 (0.001)**		
Change in CR20		-0.088 (0.004)**		-0.144 (0.004)**
Change in CR20 at county level		0.001 (0.005)		0.004 (0.005)
Change in TFP Calculated using Olley Pakes			-0.225 (0.001)**	-0.226 (0.001)**
R^2	0.14	0.14	0.14	0.14
N	733,548	733,548	733,548	733,548

Table 7

Labor Demand Determinants for China
Five year long differences using patent counts as the measure of technological change

Dependent Variable:	Change in the log of Employment at the Establishment level between year t and year t-5						Excluding SOEs
Change In CR4	-0.336 (0.026)**		-0.327 (0.026)**		-0.265 (0.024)**		-0.281 (0.026)**
Change in CR4 at County Level	-0.024 (0.021)		-0.025 (0.021)		0.015 (0.019)		-0.029 (0.022)
Change in Export Share At Sector Level	0.043 (0.015)**	0.048 (0.015)**	0.040 (0.015)**	0.045 (0.015)**	0.039 (0.014)**	0.042 (0.014)**	0.076 (0.014)**
Dpat	0.795 (0.080)**	0.798 (0.080)**			0.605 (0.076)**	0.607 (0.076)**	0.594 (0.081)**
dCR20		-0.214 (0.015)**		-0.210 (0.015)**		-0.174 (0.014)**	
dCR20_county		-0.070 (0.018)**		-0.075 (0.018)**		0.024 (0.017)	
dpat01			0.150 (0.006)**	0.151 (0.006)**			
dlogK					0.243 (0.001)**	0.243 (0.001)**	0.239 (0.001)**
_cons	-0.024 (0.004)**	-0.027 (0.004)**	-0.026 (0.004)**	-0.029 (0.004)**	-0.098 (0.004)**	-0.100 (0.004)**	-0.046 (0.004)**
R^2	0.00	0.00	0.01	0.01	0.11	0.11	0.11
N	247,681	247,681	247,681	247,681	247,681	247,681	217,373

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
AT	263,164	0.19
BA	305,812	0.22
BE	1,641,694	1.18
BG	5,291,213	3,80
CN	8,547,283	6.13
CO	3,318,870	2.38
CZ	2,047,110	1.47
DE	1,751,549	1.26
DK	187,792	0.13
DZ	232,136	0.17
EE	1,188,813	0.85
ES	14,017,507	10.06
FI	2,484,724	1.78
FR	26,648,120	19.13
GR	472,777	0.34
HR	1,495,481	1.07
HU	4,765,725	3.42
IN	613,980	0.44
IS	230,803	0.17
IT	13,249,422	9.51
JP	4,105,580	2.95
KR	4,465,769	3.21
LT	241,865	0.17
LV	1,147,642	0.82
MA	812,006	0.58
MK	510,779	0.37
MY	2,169,845	1.56
NL	244,309	0.18
NO	2,349,608	1.69
PH	120,990	0.09
PL	1,836,308	1.32
PT	4,744,813	3.41

RO	7,303,858	5.24
RS	1,393,809	1.00
SE	5,375,334	3.86
SG	342,065	0.25
SI	1,327,330	0.95
SK	1,666,758	1.20
TH	3,132,326	2.25
TW	141,558	0.10
UA	4,604,442	3.30
US	157,062	0.11
VN	2,383,389	1.71
TOTAL	139,331,420	100.00

Appendix Table A2

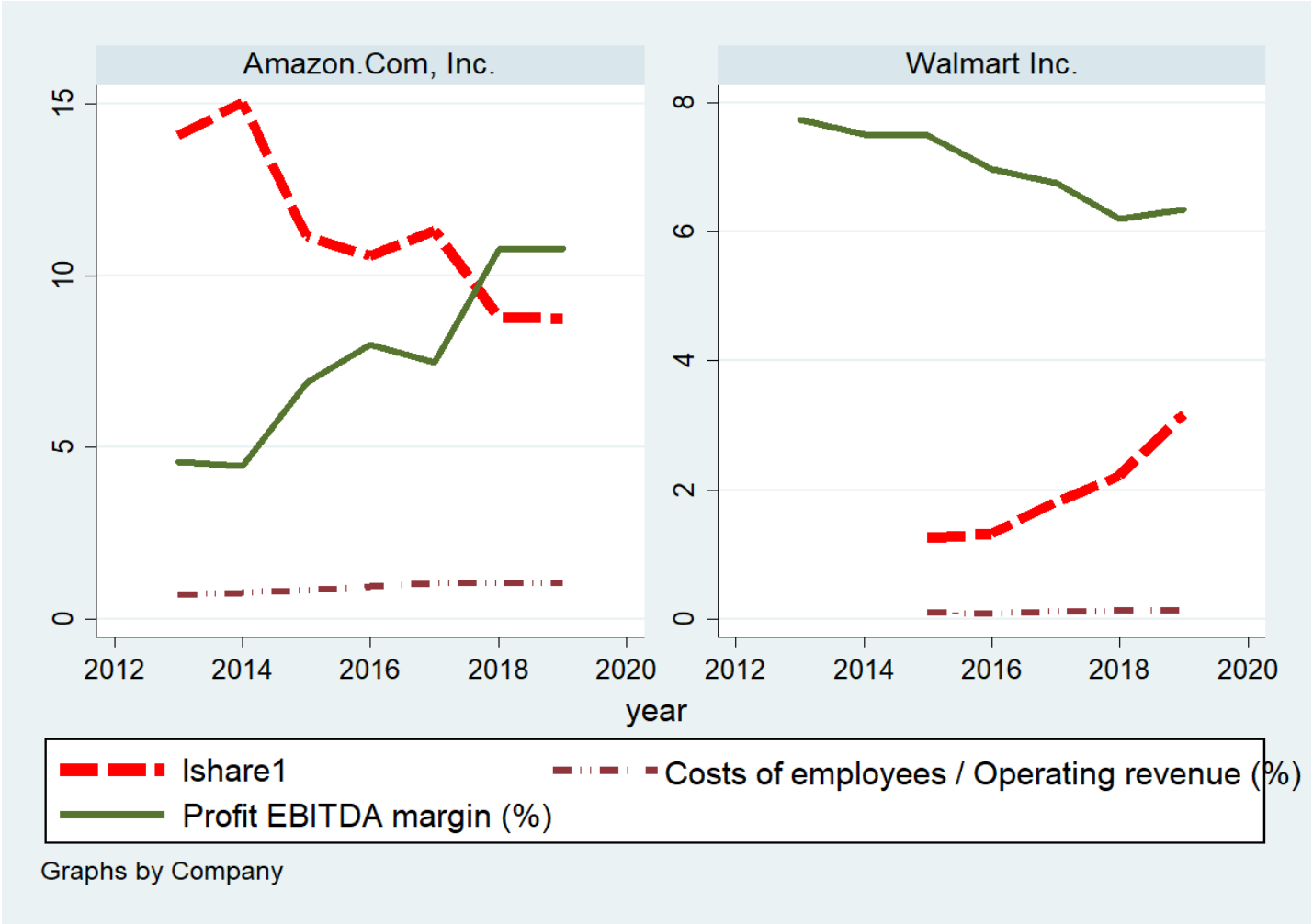
BvD major sector	Freq.	Percent	Cum.
Banks	586,804	0.42	0.42
Chemicals, rubber, plastics, non-meta..	3,492,515	2.51	2.93
Construction	16,716,787	12.00	14.93
Education, Health	4,682,746	3.36	18.29
Food, beverages, tobacco	2,731,167	1.96	20.25
Gas, Water, Electricity	873,543	0.63	20.87
Hotels & restaurants	6,729,901	4.83	25.70
Insurance companies	54,037	0.04	25.74
Machinery, equipment, furniture, recy..	7,374,811	5.29	31.04
Metals & metal products	3,624,388	2.60	33.64
Other services	41,543,345	29.82	63.45
Post & telecommunications	479,934	0.34	63.80
Primary sector	4,999,771	3.59	67.39
Public administration & defense	86,178	0.06	67.45
Publishing, printing	2,114,814	1.52	68.97
Textiles, wearing apparel, leather	2,464,516	1.77	70.73
Transport	5,435,211	3.90	74.64
Wholesale & retail trade	33,742,338	24.22	98.85
Wood, cork, paper	1,598,614	1.15	100.00
Total	139,331,420	100.00	

Appendix Table A3: Year Coverage

year	Freq.	Percent	Cum.
1995	635,015	0.46	0.46
1996	951,232	0.68	1.14
1997	1,182,118	0.85	1.99
1998	1,500,021	1.08	3.06
1999	1,741,844	1.25	4.31
2000	1,993,044	1.43	5.74

2001	2,512,884	1.80	7.55
2002	3,007,021	2.16	9.71
2003	3,447,642	2.47	12.18
2004	4,244,054	3.05	15.23
2005	4,853,368	3.48	18.71
2006	5,115,059	3.67	22.38
2007	5,684,466	4.08	26.46
2008	6,023,847	4.32	30.78
2009	6,371,751	4.57	35.36
2010	6,642,710	4.77	40.12
2011	7,284,299	5.23	45.35
2012	7,608,112	5.46	50.81
2013	9,785,067	7.02	57.84
2014	11,273,903	8.09	65.93
2015	8,330,727	5.98	71.91
2016	10,528,234	7.56	79.46
2017	8,915,552	6.40	85.86
2018	10,509,032	7.54	93.40
2019	9,190,418	6.60	100.00
Total	139,331,420	100.00	

Appendix Table A.4: Two Sample Companies--Amazon and Walmart



	Labor Share (Levels)		Change in Labor Share (Five Year Long Differences)					
CR4	-0.022 (0.007)**							
CR4_county	0.046 (0.001)**							
Trade Share (Sector)	0.005 (0.005)	0.002 (0.005)						
Patent count	-0.105 (0.048)*	-0.107 (0.048)*						
CR20		-0.048 (0.006)**						
CR20_county		0.031 (0.001)**						
Change In CR4_county			0.103 (0.007)**		0.103 (0.007)**		0.102 (0.007)**	
Change in Trade Share (Sector)			0.012 (0.005)*	0.012 (0.005)*	0.013 (0.005)**	0.012 (0.005)*	0.012 (0.005)*	0.012 (0.005)*
Change in patent count			-0.380 (0.109)**	-0.392 (0.109)**			-0.338 (0.109)**	-0.351 (0.109)**
Change in CR20				-0.016 (0.005)**		-0.016 (0.005)**		-0.017 (0.005)**
dCR20_county				0.117 (0.006)**		0.117 (0.006)**		0.115 (0.006)**
Change in patent Dummy (0 or 1)					-0.010 (0.002)**	-0.010 (0.002)**		
Change in log of Capital Stock							-0.008 (0.000)**	-0.008 (0.000)**
R^2	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00
N	1,498,179	1,498,179	188,936	188,936	188,936	188,936	188,936	188,936

* $p<0.05$; ** $p<0.01$

Appendix Table A.5 Extensions with the Chinese Census Data: Replacing TFP changes with Patent Counts and adding the Log of the Capital Stock as an Additional Control

Appendix A.6

Sectoral Means for Key Variables in 2002 and 2019

Variable Name	Rest of World	Rest of World	USA	USA	France	France
	2002	2019	2002	2019	2002	2019
Labor Share	0.55	0.52	0.50	0.25	0.75	0.67
Four Firm Concentration Ratio (CR4)	0.51	0.37	0.41	0.44	0.43	0.42
Twenty Firm Concentration Ratio (CR20)	0.72	0.59	0.72	0.77	0.64	0.64
Intangible Assets as a Share of Total Assets	0.037	0.057	0.161	0.210	0.131	0.182
Tangible Assets as a Share of Total Assets	0.40	0.33	0.34	0.35	0.22	0.18
Export Shares in Sales	0.021	0.040	n.a.	n.a.	0.17	n.a.
R and D as a Share of Sales	0.012	0.002	0.007	0.018	0.002	0.002