Corporate Tax Cuts and the Decline of the Manufacturing Labor Share

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Abstract

We document a strong empirical connection between corporate taxation and the manufacturing labor share across OECD countries as well as across US states. Our estimates associate 30% of the observed decline in the labor share with the global fall in corporate taxation. We present an equilibrium model of an industry where firms differ in their capital intensities. Lower corporate tax rates reduce the labor share by raising the market share of capital intensive firms. The tax elasticity of the aggregate labor share depends on the distribution of labor intensities at the micro level. Given the observed distribution of factor intensities in the US manufacturing industry, the model predicts that corporate tax cuts explain about 40% of the decline in the manufacturing labor share since the 1950s.

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1 Introduction

The labor share has been falling across the world, with the most striking declines observed in industries that have traditionally been more capital intensive, such as manufacturing and mining (see for instance Elsby, Hobijn, and Şahin (2013) or Karabarbounis and Neiman (2013)). In this paper we show that the decline of the labor share coincides with a global downward trend in corporate tax rates and provide a framework to measure the contribution of lower corporate tax rates to the decline of the labor share. The results indicate that 30 to 40 percent of the decline in the manufacturing labor share is associated with the fall in corporate taxation.

We begin our analysis by studying the empirical relation between corporate taxation and the labor share across countries. Among the OECD countries in our sample the aggregate labor share declined by 0.26 percentage points (pp) every year between 1981 and 2007. In manufacturing the average decrease was 0.34pp per year. During the same period corporate tax rates dropped by 19pp on average. The labor share fell by more in countries with larger declines in the corporate tax rate. We estimate that every 10pp decline in the corporate tax rate is associated with a one percentage point drop in the aggregate labor share. In manufacturing, where a particular sensitivity to the tax rate is expected because of a higher capital intensity, the same decline in the corporate tax rate is associated with a 1.8pp drop in the labor share. Among OECD countries, the decline in corporate tax rates explains 31% of the observed fall in the manufacturing labor share and 26% of the fall in the aggregate labor share.

A similar pattern appears in the US manufacturing sector, where the labor share has been consistently declining since the 1950s. The share of total labor compensation in value added decreased from 60% in 1954 to 34% in 2014.[1] During the same period the effective tax rate on corporate income in the US has fallen from 50% to 20%.[2] Using the variation in state level effective corporate tax rates between 1972 and 2007, we find that lower corporate income tax rates

[1]In our analysis of the US manufacturing industry the labor share refers to the payroll share at operating manufacturing establishments and is defined as the ratio of total labor compensation and total value added. See Appendix A for detailed data definitions.

[2]These figures come from Gravelle (2004) and Congressional Budget Office (2014) and represent the estimated average marginal tax rates.

are associated with a significant decline in the state's manufacturing payroll share.

Motivated by these facts, we propose a model to study the impact of corporate taxation on the size distribution of firms and the labor share in US manufacturing. In the model, firms differ in their capital intensity as well as their productivity. The equilibrium industry labor share is determined by the joint distribution of capital intensities and output shares. The differences in firms' factor intensities translate into heterogeneous factor price elasticities. As a result, the distribution of firm level output shares depends on the relative costs of capital and labor.

In this setting, a reduction in the corporate tax rate lowers the cost of capital. This disproportionately benefits capital intensive firms and allows them to capture a larger share of the market, resulting in a lower aggregate labor share. The decline in the labor share is exacerbated by the equilibrium effect on the industry's price level. The lower tax rate raises profits in the industry and attracts firm entry, resulting in lower prices. This raises the effective real wage in the industry. The higher cost of labor reduces the market share of labor intensive firms and contributes to the decline in the industry's labor share. The extent of this decline depends on the micro-level distribution of capital intensities in the industry. In particular, we show that the net-of-tax elasticity of the industry's labor share depends on the coefficient of variation of labor intensities at the establishment level. Capital intensive industries and those where factor intensities are more diverse are expected to experience larger declines in their labor share in response to a drop in the corporate tax rate.

The model predicts that the rise in the concentration of value added is not reflected in the concentration of employment. This is because the expansion of output implied by lower corporate tax rates is led primarily by capital intensive firms. Labor-intensive firms, initially among the largest employers, shrink in size, both in terms of output and employment.

There is support for these predictions in the US manufacturing data. The recent literature has established that a large part of the decline in the labor share took place within narrowly defined industries, caused by a reallocation of market shares from labor intensive establishments to capital intensive ones (Autor, Dorn, Katz, Patterson, and Van Reenen, 2017; Kehrig and Vincent, 2018). In their analysis of manufacturing establishments, Kehrig and Vincent (2018) document that the distribution of labor shares across establishments has remained almost unchanged. Despite the concentration of market share, we find that at the same time the manufacturing sector experienced a decline in employment concentration. Data from the Business Dynamics Statistics (BDS) shows that the concentration index, defined by the inverse Pareto index implied by the employment share of the largest firms, declined from 0.86 in 1977 to 0.78 in 2014.[3] A similar pattern is seen in the mining sector, where the labor share has declined significantly, but not in other industries where the decline of the labor share has been more limited.

To quantify the impact of the fall in corporate taxation on the manufacturing labor share, we calibrate our model to 1967 US manufacturing data. The model closely replicates the joint distribution of labor shares and value added as well as the firm size distribution. We first simulate an economy with an effective corporate tax rate of 50%, as estimated for 1954, and then lower this rate to 20%, as estimated for 2014. The model predicts a decline of the industry labor share by 10pp. Given the US manufacturing sector's observed total decline of 26pp between 1954 and 2014, we conclude that lower corporate tax rates are responsible for more than a third of the total fall.

Our paper contributes to the recent literature on the causes of the decline in the labor share. Several studies focus on aspects of the production function as an explanation. Karabarbounis and Neiman (2013) argue that a decreasing price of capital equipment in recent decades has led to capital deepening and reduced the labor share of output, implying that capital and labor are substitutes in production (with an elasticity of substitution greater than one). Lawrence (2015) on the other hand, argues that capital and labor are complements and attributes the fall of the labor share to effective labor deepening that resulted from labor-augmenting technical change. Alvarez-Cuadrado, Van Long, and Poschke (2018) assume that labor and capital are gross complements, and argue that the fall in the labor share is a result of differences in the paces of capital-biased

[3] The largest firms are defined as those with ten thousand or more employees, the largest category reported by the BDS. Letting s_{f10K} denote the share of firms with more than ten thousand employees, and e_{10K} their share in total employment, the Pareto index is computed by $\iota_P = \log s_{f10K}/(\log s_{f10K} - \log e_{f10K})$. The same pattern is observed with other employment size classes and among establishments as well as firms. See Figure 6a and Figure 10 in Appendix A.1.

technical change in the services and manufacturing sectors.

Another strand of papers focuses on changes in the market structure to explain the fall in the labor share. Autor et al. (2017) argue that the increase in market concentration is the result of a rising price elasticity of demand which led to an increase in product competition among firms and resulted in the most efficient (and capital intensive) firms grabbing a larger share of the market. On the other hand, De Loecker and Eeckhout (2017) find that market power has increased in the US. This would raise the profit share at the expense of the labor and capital shares. Our paper differs from the existing literature by focusing on an institutional element, namely corporate taxation. Broadly speaking, the literature has largely ignored institutional elements that may potentially be responsible for the decline of the labor share.[4]

We use our model to assess the implications of a higher price elasticity of demand and higher markups for the labor share, as well as for the distributions of employment and value added in manufacturing. In the context of our model, a higher price elasticity of demand captures most of the salient features of the data, such as a higher concentration of value added among capital intensive firms and a decline of the labor share. However, this is accompanied by a sizeable increase in the concentration of employment among large establishments, a pattern that is at odds with the US manufacturing data. This suggests that across industries, different factors may have been the dominant driving force behind the decline in the labor share. Higher markups, perhaps surprisingly, slightly *raise* the labor share due to counteracting equilibrium effects on the industry price level. Higher market power essentially leads to higher prices, lowering the effective real wage. Lower labor costs help labor intensive firms raise their market share and offset the direct effect of higher markups.

In the next section, we provide empirical evidence for the relation between corporate taxation and the labor share. In Section 3, we present our model. Section 4 provides analytical results on the tax elasticity of the labor share. Section 5 presents a quantitative evaluation of the impact of lower corporate taxes on the US manufacturing labor share. Section 6 provides quantitative evaluations

[4]One exception is Elsby et al. (2013), who consider deunionization in the US as a potential cause of the decline of the labor share, but find little correlation between the rate of unionization and the labor share across industries.

of alternative explanations proposed in the literature. Section 7 concludes.

2 Empirical Evidence

In this section we empirically investigate the link between corporate taxation and the labor share. We study changes in labor shares across countries, as well as across states in the US.[5]

2.1 The Labor Share in OECD Countries

The first part of our analysis is at the country level and covers the 1981 to 2007 period for a set of OECD countries. The data on labor shares comes from the World KLEMS database. Corporate tax rates are taken from the OECD and represent the combined central and sub-central statutory tax rate.[6]

Between 1981 and 2007 labor shares have fallen considerably. For the countries we observe throughout the sample period, the average fall in the aggregate labor share has been 0.26pp per year. This trend is more pronounced in the manufacturing sector, where the labor share fell by 0.34pp per year. This pattern is shared by most countries. The largest declines in manufacturing labor shares occurred in Sweden, Austria, and Ireland, with total drops of well over 20pp. The smallest changes occurred in Spain, Italy, and France.

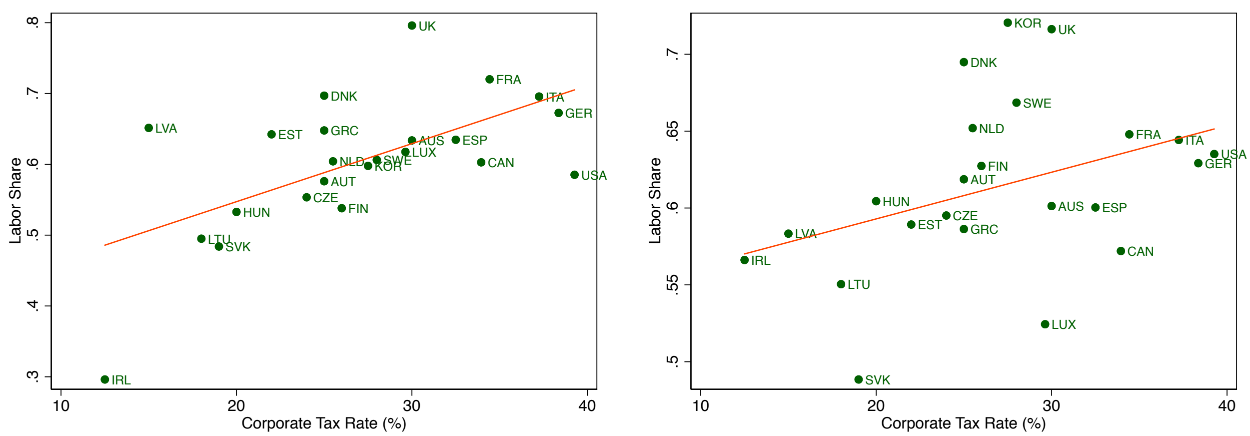
At the same time, there have been significant cuts in corporate tax rates. For the same set of countries, the average decline in the corporate tax rate between 1981 and 2007 has been 19pp, with substantial variation across countries. Among the countries with the largest cuts are Finland, Ireland, Austria, and Sweden with declines of over 30pp (see Klein and Ventura (2018) for a detailed analysis of the business tax reform in Ireland). Almost no change in corporate tax rates occurred in Italy and Spain (see Appendix A.1 for detailed graphs).

[5] Details on the construction of our datasets can be found in Appendix A.

[6] We use statutory tax rates in our cross-country analysis. The operating assumption behind our analysis is that the relative changes in the statutory tax rates are representative of the relative changes in the effective tax rates across countries.

Figure 1: Corporate Tax Rate and Labor Share in the Manufacturing Sector

(a) Manufacturing (b) Aggregate



Note.– Data shows the statutory corporate tax rate and the labor's share of income in the manufacturing sector and the aggregate economy for 2007. The correlation coefficient is 0.60 (s.e. 0.14) for the manufacturing sector and 0.39 (s.e. 0.17) for the aggregate economy. Source: OECD and KLEMS.

At a cross-sectional level, there is a strong correlation between the corporate tax rate and labor's share of income. Figure 1 shows a scatter plot of the two variables in 2007 for manufacturing and the aggregate economy. The correlation coefficient is 0.60 (s.e. 0.14) for manufacturing and 0.39 (s.e. 0.17) for the aggregate economy. The fact that the correlation is higher for manufacturing is not surprising. Because labor costs are deducted from the corporate tax base, the tax burden essentially falls on capital. As a result, capital intensive sectors are more sensitive to changes in the corporate tax rate.

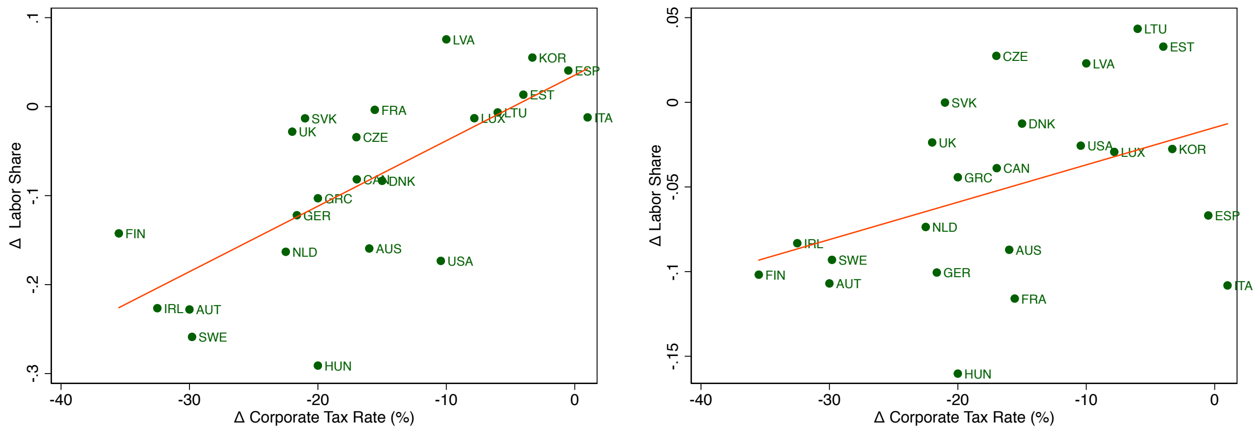
In Figure 2 we plot country-level changes in the labor share against changes in the corporate tax rate. There is a strong positive correlation between the two variables, especially in the manufacturing sector, where the correlation coefficient is 0.71 (s.e. 0.12). Countries that implemented larger cuts in corporate tax rates experienced a faster fall in labor's share of income. A similar relation is also observed for the aggregate economy, with a correlation coefficient of 0.41 (s.e. 0.17).

To test the relationship between the two variables more formally, we regress the labor share on the corporate tax rate, controlling for fixed country and year effects. The results are reported in Table 1. In manufacturing, the coefficient on the corporate tax rate is 0.36 with a standard error of

Figure 2: Trends in Corporate Tax Rate and Labor Share: 1981 - 2007

(a) Manufacturing

(b) Aggregate



Note.– Data shows the changes in statutory corporate tax rate and the labor's share of income between 1981 and 2007. The correlation coefficient is 0.71 (s.e. 0.12) for the manufacturing sector and 0.41 (s.e. 0.17) for the aggregate economy. Source: OECD and KLEMS.

0.09, which implies a p-value of less than 0.1%. On the aggregate, the results suggest that a 10pp drop in the corporate tax rate is associated with 1.2pp drop in a country's labor share.[7]

One concern with these results may be the presence of other factors that lead to a decline in the labor share and that may be correlated with changes in the corporate tax rate during the sample period. To address this concern, columns 3-4 in Table 1 include country-specific trends in the labor share for each sector. The coefficient of the corporate tax rate is therefore identified by the accelerations and decelerations in the pace of the decline of the labor share. For the manufacturing sample, the coefficient on the corporate tax rate is somewhat smaller at 0.18, but still statistically significant with a p-value of less than 1%. The coefficient for the aggregate economy remains almost unchanged at 0.10 (s.e. 0.05).

Given the observed declines in the tax rates, the coefficients obtained in Columns 3 and 4 of Table 1 imply that, on average, the corporate tax cuts are associated with a 4.0pp drop in the

[7] In Table 1, we use a levels specification. An alternative would be to estimate a difference specification. To check the sensitivity of the results to specification, we regressed the 10-year changes in the labor share on the 10-year changes in the corporate tax rate. The coefficients are similar with 0.31 (0.11) for manufacturing and 0.16 (0.05) for the aggregate economy.

Table 1: Corporate Taxation and the Labor Share

	(1) Manufacturing	(2) Aggregate	(3) Manufacturing	(4) Aggregate
Corporate tax rate	0.36***	0.12*	0.18**	0.10*
	(0.09)	(0.04)	(0.06)	(0.05)
Country trends	No	No	Yes	Yes
N	579	579	579	579

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.– Data comes from the KLEMS database and OECD, and covers the years 1981 to 2007. Dependent variable is labor's share of income. All specifications control for fixed year and country effects. Specifications (3)-(4) control for country-specific linear trends. Standard errors are clustered at the country level.

manufacturing labor share and a 2.8pp drop in the aggregate labor share throughout the sample period. The corporate tax cuts can account for 31 percent of the total decline in the manufacturing labor share, and 26 percent of the aggregate labor share.

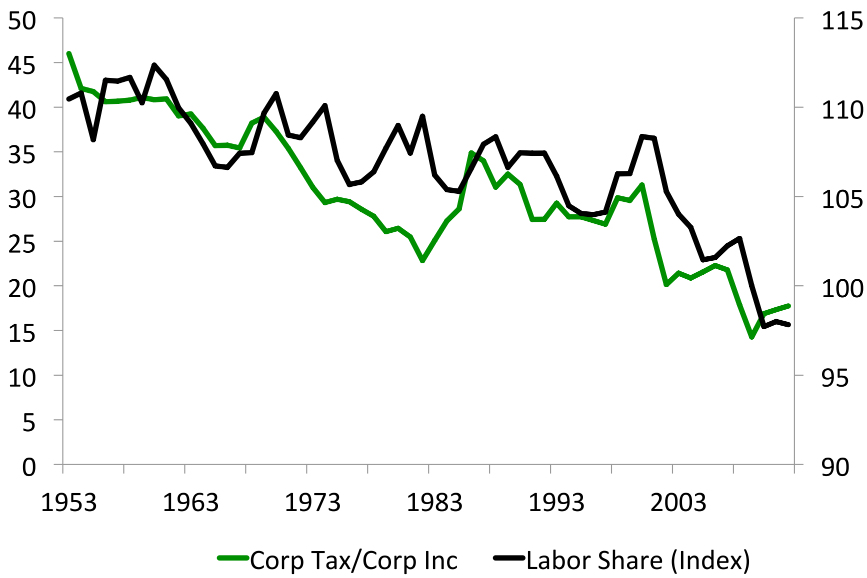
Our takeaway from the cross-country analysis is that there exists a strong empirical link between corporate tax rates and labor's share of income, especially in the manufacturing sector. Next, we turn our attention to the US.

2.2 The Labor Share in the US

The global trend in the labor share and corporate taxation is also mirrored in the US. Figure 3 shows the BLS labor share index for the aggregate economy along with the average tax rates on corporations as measured by the ratio of corporate tax collections to corporate income. The aggregate labor share index fell by 13.5% between 1953 and 2012. At the same time, the effective corporate tax rate fell from 46% in the 1950s to 18% in 2012. Apart from the 1970s, the two series closely follow each other, hinting at a positive association between capital taxes and the labor share.

Next, we use variation in state level corporate tax rates to assess the impact of lower corporate taxes on manufacturing labor shares. We define each state's effective corporate tax rate as the ratio of state revenue from taxation of corporate income divided by the total gross operating surplus in

Figure 3: Capital Taxation and Labor's Share of Income in the US



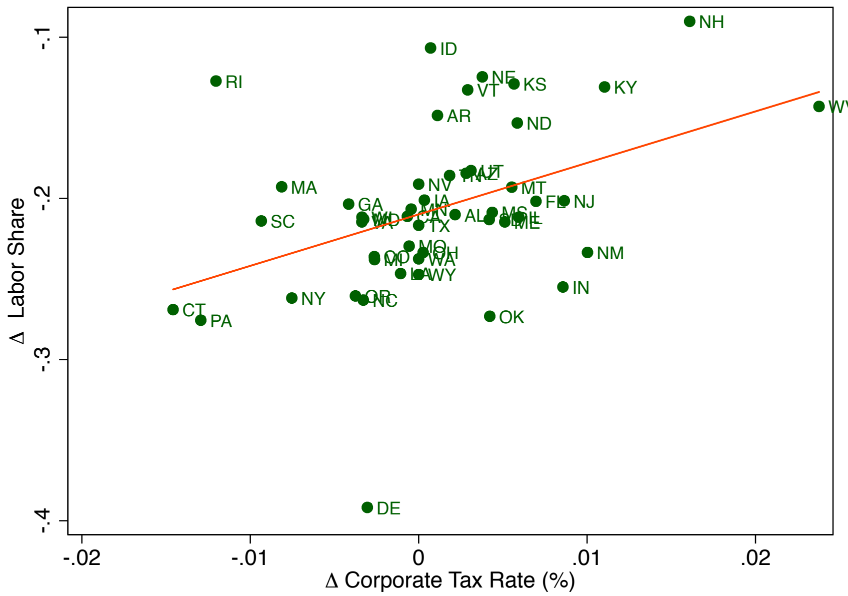
Notes.– Figure shows the evolution the labor share and effective tax rates on capital in US. Labor share index is obtained from BLS. The effective capital tax rates are computed as the ratio of corporate income tax revenues to corporate income.

that state. The dependent variable is the payroll share in manufacturing, obtained from the Census of Manufactures every five years between 1972 and 2007.

Both labor shares and corporate tax rates vary across states and time. Manufacturing labor shares have fallen in all states, with the largest drops observed in Delaware and Pennsylvania and the smallest occurring in New Hampshire. State-level corporate tax rates are low compared to federal levels and there are several states that levy no or very little corporate income tax. In 2007, average tax rates ranged from 0% to 4.2%. Different from federal rates, state-level rates do not show a clear downwards trend over time. Figure 4 plots the change in states' labor shares against the changes in average corporate tax rates between 1972 and 2007 (see Appendix A.1 for detailed graphs). We find a strong positive link between the two variables: States with larger decreases in the state-level corporate tax rate experienced a larger fall in the labor share. The correlation coefficient between the two variables is 0.42 (se. 0.11).

Table 2 shows the estimates from a regression of state level manufacturing payroll shares on

Figure 4: Corporate Tax Rate and the Manufacturing Payroll Share in the US: 1972 - 2007



Notes.– Graph shows the state-level changes in the manufacturing sector payroll share and the average corporate tax rate. The correlation coefficient between the two variables is 0.42 (se. 0.11)

the state's average corporate tax rate. The specification in the first column includes state and year effects. The coefficient implies that a one percentage point drop in a state's average corporate tax rate is associated with a 2.35pp drop in its manufacturing labor share. This is large. If extrapolated, this suggests that the drop in the *federal* tax rates explains the entire fall in the labor share since the 1950s. We think, however, that the state level regressions likely exaggerate the response of the aggregate labor share in manufacturing to federal tax rates. The reason is that establishments can relocate freely across states, potentially leading to a higher tax elasticity at the state level than at the aggregate level. Another possibility is that changes in the tax rates pick up effects of other state-level changes that are not included in the regression. To control for those effects, we include state-specific trends in the regression and report the results in the second column of Table 2. The resulting coefficient is 2.62 (s.e. 0.82), suggesting that the result is not driven by a spurious correlation between trends in labor shares and tax rates at the state level. The next two columns control for the changes in labor costs proxied by the state's average wage and salary disbursements during the year. The coefficient on the corporate tax rate remains similar.

Table 2: Corporate Taxation and the Labor Share across US States

	(1)	(2)	(3)	(4)	(5)	(6)
Corporate tax rate	2.35**	2.62**	2.80***	2.81**	3.47***	3.23**
	(0.74)	(0.82)	(0.69)	(0.81)	(0.77)	(1.08)
log wage			0.08	0.08	0.12*	0.12
			(0.04)	(0.05)	(0.04)	(0.07)
Unemployment rate					0.54*	0.26
					(0.21)	(0.17)
State trends	no	yes	no	yes	no	yes
N	384	384	384	384	336	336

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.– The dependent variable is the payroll share of value added in the manufacturing sector of a state. Corporate tax rate denotes the average corporate tax rate in a state. All specifications control for indicators for year and state effects. Standard errors are clustered at the state level. Data comes from the Annual Survey of Manufactures 1972 - 2012, the BEA, and Suárez Serrato and Zidar (2016). The last two columns cover the 1977 to 2012 period.

It is plausible that corporate tax rates react to economic conditions and are therefore not exogenous to the labor share. While our goal in this section is not to establish causality, we think that such endogeneity renders our estimates conservative. A procyclical tax policy, designed for instance to smooth out cyclical fluctuations, would bias the estimates downwards because the labor share is known to be countercyclical. Indeed, when we include the state unemployment rate as a control variable in column (5) of Table 2, the coefficient on the average tax rate increases to 3.47 (0.77).

These empirical patterns indicate that falling corporate tax rates are an important factor in understanding the decline of the labor share. Next, we take a more structural approach. In particular, we develop a model that captures salient features of the US manufacturing industry in the 1960s, and then simulate counterfactual economies with lower corporate tax rates to gauge the impact of corporate taxes on the labor share. The model allows us to consider several implications of lower taxation at once, including the distribution of value added and employment among establishments. It also allows us to compare and evaluate the alternative explanations proposed in the literature.

3 Model

The model we employ is an industry equilibrium model in the spirit of Hopenhayn (1992) and Hopenhayn and Rogerson (1993), modified to include corporate taxes and heterogeneity in labor intensities.

Time is discrete and the horizon is infinite. The economy consists of a measure of heterogeneous firms, a representative household, and a government. At time t, a positive mass of price-taking firms produces a homogenous output good with capital and labor. Firms differ in their time-invariant capital intensity α_i and their productivity level ε_i. At time t a firm i produces output according to $q_{it} = \varepsilon_i({k_{it}}^{\alpha_i}{n_{it}}^{\beta_i})$.[8] The production function displays diminishing returns to scale: $\alpha_i + \beta_i = \gamma < 1 \quad \forall i$.

Firms accumulate capital, hire labor services on the spot market at the wage rate w, and discount future profits with $\rho \in (0, 1)$. Capital depreciates at rate $\delta \in (0, 1)$. Operating firms incur an operational cost of $c_f \geq 0$ each period.

A linear corporate income tax τ is imposed on firms' net income. The proceeds from taxation are redistributed to the representative household in a lump-sum fashion, ensuring a balanced budget at all times.

Plants may die stochastically at an exogenous rate x which is orthogonal to a firm's productivity level and capital share.[9] Once a firm exits, it cannot re-enter the market at a later period. It liquidates all remaining available resources and distributes them to its shareholders.

Every period there is a large mass of potential entrants, of whom a constant mass $M > 0$ enters the industry. Upon paying the entry cost $c_e \geq 0$, firms draw a permanent productivity level ε_i from a normal distribution with $\log \varepsilon_i \sim N(\mu_\varepsilon, \sigma_\varepsilon)$ with density $H(\varepsilon)$, and a value of α from the density $G(\alpha)$. [10] The draws for productivity and capital share are assumed to be independent.

The representative household supplies labor to the production sector in return for wage income,

[8] Note that output and value added are identical in our model. We use the terms interchangeably throughout.

[9] In their analysis of the manufacturing sector Kehrig and Vincent (2018) do not find any role for entry and exit in the decline of the labor share.

[10] Augmenting the model with time-varying idiosyncratic productivity is straightforward but has virtually no quantitative impact on our results.

collects dividends from operational firms and the tax rebate from the government, and consumes the output.

3.1 Incumbent Firm's Problem

An incumbent firm is defined by its capital share α and productivity ε. At the beginning of a period, given a level of capital determined by past investment choices, firms hire labor, produce and sell their output, and pay wages and a fixed cost of operation. Profits net of depreciation, $\pi_b(\varepsilon, \alpha)$, constitute the tax base and are defined as

$$\pi_b(\varepsilon, \alpha) = p\varepsilon k^{\alpha} n^{\beta} - wn - pc_f - p\delta k. \tag{1}$$

A fraction $\tau > 0$ of net income is owed in taxes if net income is positive.

The value of a firm with capital-share α and productivity ε is given below.[11]

$$V(\varepsilon, \alpha) = \frac{1}{1-\tilde{\rho}} \cdot \max_{k,n} \Big\{ -pk + \tilde{\rho}\Big(\pi_b(\varepsilon, \alpha) - \tau \cdot \max\{0, \pi_b(\varepsilon, \alpha)\} + pk\Big)\Big\}, \tag{2}$$

The expression in (2) says that the firm chooses k and n to maximize the value of the firm. If profits are negative, the tax liability is zero. This is captured by the second $\max$ operator in (2). The effective discount rate is denoted as $\tilde{\rho} = \rho \cdot (1 - x)$ and includes the probability of firm survival.

3.2 Entrant's Problem

There is a large mass of ex-ante identical potential entrants, who begin operating if the value of entry exceeds the cost of entry c_e. This can be interpreted as a cost of setting up shop, finding a customer target group, etc. Once the entry cost has been paid, the firm's permanent values of α and ε are revealed. The new firm then chooses a level of investment for the first period of operation.

[11] A period in the solution of the model begins after production. In this way, an incumbent firm's current capital stock k is not part of its state vector.

The value function of a potential entrant is given by

$$V^e = \int \int V(\varepsilon, \alpha) dH(\varepsilon) dG(\alpha) - pc_e. \tag{3}$$

The right-hand side of (3) represents the expected value of an incumbent firm minus the entry cost. This implies that the free-entry condition is given by

$$pc_e = \int \int V(\varepsilon, \alpha) dH(\varepsilon) dG(\alpha). \tag{4}$$

At any equilibrium with positive entry, equation (4) holds. A rise in the average value of an incumbent firm attracts more entry, leading to a fall in the equilibrium price level p to ensure that the value of entry equals the cost of entry.

3.3 Distribution of Firms

We denote the distribution of incumbent firms defined over the space of capital share types and productivity as $\mathbf{\Gamma}$. The evolution of $\mathbf{\Gamma}$ over time due to entry, exit and productivity shocks is given by

$$\mathbf{\Gamma}'(\varepsilon, \alpha) = \int_\alpha \int_\varepsilon (1 - x) \left(\mathbf{\Gamma}(\varepsilon, \alpha) dH(\varepsilon) dG(\alpha) + \mu(\varepsilon, \alpha) \right),$$

where the measure of entrants is given by:

$$\mu(\varepsilon, \alpha) = M \int_\alpha \int_\varepsilon dH(\varepsilon) dG(\alpha)$$

3.4 Households

There is a representative household that derives utility from consumption and disutility from labor. The income of the representative household consists of labor earnings, dividends, and transfers from the government. We assume an exogenous labor supply, which we normalize to one.

$$\max_{c,n} \frac{c^{1-\sigma}}{1-\sigma} \qquad s.t.\ pc = w + d + T$$

Because the investment decision is handled by firms, the household's problem is static.

3.5 Competitive Equilibrium

A stationary recursive competitive equilibrium consists of a value function $V(\varepsilon, \alpha)$, policy functions $k(\varepsilon, \alpha)$, $n(\varepsilon, \alpha)$, prices for goods and labor, p and w, a measure of incumbent firms $\mathbf{\Gamma}$, and a measure of entrants μ such that *i)* $V(\varepsilon, \alpha)$, $k(\varepsilon, \alpha)$, and $n(\varepsilon, \alpha)$ solve the incumbent firm's problem, *ii)* the free entry condition (4) is satisfied, *iii)* the labor market clears at w: $\int n(\varepsilon, \alpha) d\mathbf{\Gamma} = 1$, *iv)* the financial market clears at: $d = \int \left[\pi_b(\varepsilon, \alpha) - \tau \cdot \max\{0, \pi_b(\varepsilon, \alpha)\}\right] d\mathbf{\Gamma} - Mpc_e$, *v)* the government budget is balanced: $T = \tau \int \max\{0, \pi_b(\varepsilon, \alpha)\} d\mathbf{\Gamma}$, and *vi)* the distribution of incumbent firms is stationary: $\mathbf{\Gamma}' = \mathbf{\Gamma}$.

The fourth condition above defines the total amount of dividends paid to the representative household. Dividends are given by profits net of taxes. The government levies taxes on corporate income and redistributes the proceeds to the representative household in a lump-sum fashion, ensuring a balanced budget at all times.

4 Corporate Taxes and the Industry Labor Share

In this section we analyze the model equilibrium and demonstrate the implications of corporate taxation for the industry labor share. To maintain tractability we make a few simplifications. First, for exposition, we aggregate firms with different idiosyncratic productivity ε but the same level of capital intensity α. This yields a representative firm for each type α with the production function $q(k, n, \alpha) = \mathbb{E}[\varepsilon^{\frac{1}{1-\gamma}}] k^{\alpha} n^{\beta}$. Without loss of generality, we normalize productivity such that $\mathbb{E}[\varepsilon^{\frac{1}{1-\gamma}}] = 1$. We return to the original formulation for the quantitative analysis in Section 5. Because exit is exogenous, we set the fixed cost of operation to $c_f = 0$. This ensures that firm income net of depreciation is always non-negative and avoids kinks in factor demand functions otherwise caused by loss provisions in the tax code. This does not change our results in a qualitative way.

In what follows, we will first establish the relationship between factor prices and the distribution of value added among firms with different capital intensities. This allows us to translate changes in relative factor prices to changes in industry factor shares. The partial equilibrium effects are analyzed first, followed by the general equilibrium effects that arise from changes in industry prices. We conclude by linking the effects of a change in the tax rate to equilibrium prices and establish our main result.

The optimal capital and labor demand functions implied by the firm's problem defined in (2) are given by

$$n(\alpha) = \left(\frac{\beta}{\bar{w}}\right)^{\frac{1-\alpha}{1-\gamma}} \left(\frac{\alpha}{r_\tau}\right)^{\frac{\alpha}{1-\gamma}} \qquad\qquad k(\alpha) = \left(\frac{\beta}{\bar{w}}\right)^{\frac{\beta}{1-\gamma}} \left(\frac{\alpha}{r_\tau}\right)^{\frac{1-\beta}{1-\gamma}}, \tag{5}$$

where $\bar{w} = w/p$ is the real wage and $r_\tau \equiv \frac{1-\tilde{\rho}}{\tilde{\rho}\cdot(1-\tau)} + \delta$ denotes the gross user cost of capital as a function of the effective discount rate, the corporate tax rate, and the depreciation rate. Clearly, the user cost of capital r_τ is increasing in the corporate tax rate τ, while the real wage $\bar{w}$ is decreasing in the price of the output good, p. Note that for a given level of capital, labor demand is undistorted by the corporate tax rate because labor costs are deducted from taxable income in (1). On the other hand, corporate taxes directly affect capital demand by increasing the effective cost of capital r_τ. Combining the factor demand functions in (5), output is given by

$$q(\alpha) = \left(\frac{\alpha}{r_\tau}\right)^{\frac{\alpha}{1-\gamma}} \left(\frac{\beta}{\bar{w}}\right)^{\frac{\beta}{1-\gamma}}, \tag{6}$$

and the correspnding capital and labor cost elasticities of output are

$$\eta_{q,r_\tau} = -\frac{\alpha}{1-\gamma} \qquad\qquad \eta_{q,\bar{w}} = -\frac{\beta}{1-\gamma}. \tag{7}$$

Capital-intensive firms (those with higher α) are relatively more sensitive to changes in the cost of capital and less sensitive to changes in the cost of labor. Similarly, changes in the real wage, $\bar{w}$, lead to stronger changes in output in labor-intensive firms. As a result, the distribution of value added across firms depends on the relative cost of capital and labor.

Next, we analyze how changes in factor prices affect factor shares. The industry labor share $\hat{\beta}$ is a weighted average of micro-level labor shares:

$$\hat{\beta} = \int \lambda(\alpha)\beta(\alpha)dG(\alpha) = \gamma - \int \lambda(\alpha)\alpha dG(\alpha) = \gamma - \hat{\alpha}, \tag{8}$$

with value added weights $\lambda(\alpha)$ given by

$$\lambda = \frac{q(\alpha)}{\int q(\alpha)dG(\alpha)}. \tag{9}$$

Changes in the aggregate labor share in the model are driven entirely by changes in the distribution of value added, as $G(\alpha)$ is fixed. The following Lemma establishes how a firm's output weight $\lambda(\alpha)$ responds to changes in factor prices.[12]

Lemma 1 *The elasticities of the value added shares $\lambda(\alpha)$ with respect to factor prices r_τ and $\bar{w}$ are given by:*

$$\eta_{\lambda,r_\tau} = -\frac{\alpha - \hat{\alpha}}{1-\gamma} \qquad\qquad \eta_{\lambda,\bar{w}} = \frac{\alpha - \hat{\alpha}}{1-\gamma}.$$

Lemma 1 shows that the elasticity of the share of type-α firms in total value added depends on their relative capital intensity. Following a drop in the cost of capital, firms with above-average capital intensities see a rise in their value added shares, while those with below-average intensities see a decline. These changes reduce the aggregate labor share. The proposition below reports the magnitude of this effect in partial equilibrium.

Proposition 1 *For a given price level p, a decrease in the cost of capital (or an increase in the*

[12] All proofs can be found in Appendix B.

real wage rate) lowers the aggregate labor share, with the marginal changes given by:

$$\frac{d\hat{\beta}}{dr_\tau} r_\tau = -\frac{d\hat{\alpha}}{dr_\tau} r_\tau = \frac{\sigma_\alpha^2}{1-\gamma} \qquad\qquad \frac{d\hat{\beta}}{d\bar{w}} \bar{w} = -\frac{d\hat{\alpha}}{d\bar{w}} \bar{w} = -\frac{\sigma_\alpha^2}{1-\gamma}.$$

The marginal effect of a change in the cost of capital depends on the variance of capital intensities in the economy. When $\sigma_\alpha^2 = 0$, all firms have the same constant capital intensity, which does not react to relative factor prices. When there is dispersion in capital intensities, the aggregate labor share falls if labor becomes relatively more expensive, even for a constant distribution of factor intensities among firms. The larger the dispersion in factor intensities, the more sensitive is the aggregate labor share to changes in factor prices.

Next, we discuss the impact of the corporate tax rate on the equilibrium relative factor prices. There are two effects to consider in particular: a direct effect of lower taxes on the cost of capital, r_τ, and an indirect effect on the real wage rate, via the equilibrium price level p. For a given price level, a lower tax rate renders capital relatively less expensive, resulting in a lower aggregate labor share as established in Proposition 1. The change in the equilibrium price level amplifies this effect. To see this, note that factor demand, output, and profits all increase following a decrease in the tax rate τ. This raises firm value and encourages entry intro the industry, resulting in a lower equilibrium price level. Lemma 2 and Proposition 2 below formalize this result.

Lemma 2 *Firm value is decreasing in τ and increasing in p.*

Combining Lemma 2 with the free-entry condition implies the following proposition.

Proposition 2 *With free entry, the equilibrium real wage, w/p, is increasing in the tax rate, τ.*

A fall in the equilibrium price level raises the effective real wage rate, which lowers the output shares of labor intensive firms and hence results in a further drop in the aggregate labor share. Together, Propositions 1 and 2 determine the total effect of a fall in the corporate tax rate on the aggregate labor share. The following proposition combines the partial and general equilibrium effects and gives the main result of this section.

Proposition 3 *The elasticity of the aggregate labor share with respect to the net-of-tax rate is given by:*

$$\eta_{\hat{\beta},(1-\tau)} = -\left(\frac{\sigma_\beta}{\hat{\beta}}\right)^2 \frac{1-\gamma\frac{\delta}{r_\tau}}{1-\gamma} < 0$$

The overall decline in the aggregate labor share in response to lower taxes depends on *i)* the tax-elasticity of the user cost of capital, *ii)* the cost elasticity of industry prices, and *iii)* the dispersion of factor intensities in the industry. Increases in either of these factors lead to larger declines in the aggregate labor share. Proposition 3 shows that these three factors simplify to an expression that depends on the coefficient of variation of micro-level labor intensities. Therefore it is increasing in the dispersion of firm-level labor intensities and decreasing in the level of the industry's labor share. The second term in the proposition implies that a higher value of γ is associated with a larger decline in the labor share, as it raises the elasticity of output with respect to factor prices. The numerator of the second term stems from the fact that the corporate tax rate only affects a portion of the rental cost of capital, which prevents one for one drops in the rental cost in response to the tax rate.[13]

5 Quantitative Results

In this section, we provide a measure of the contribution of lower corporate tax rates for the decline in the labor share in manufacturing. Proposition 3 above showed that the elasticity of the industry's labor share depends on the micro-level distribution of factor intensities, as well as the distribution of value added. We therefore calibrate the model to match the distributions of labor intensities, employment, and value added in the manufacturing sector in 1967.[14] We then simulate two economies: one where the corporate tax rate is 50%, the effective marginal corporate tax rate estimated by Gravelle (2004) for 1954, and one with a 20% corporate tax rate, the estimated

[13]If depreciation expenses were not tax-deductible, this term would be 1.

[14]The reason for calibrating to 1967 data is that this is the first year for which Census of Manufacturers information on the joint distribution of labor shares and value added is available.

marginal rate provided by Congressional Budget Office (2014).[15] We keep all other primitives constant to focus on the marginal contribution of corporate taxation, which is the difference in the predicted labor shares for 1954 and 2014. We also compare the model's predictions for the distributions of employment and value added with data for the US manufacturing sector. Throughout our analysis, we compare long-run equilibria associated with different tax policies. Each equilibrium has a stationary distribution of firms in the industry and features a positive entry rate.

5.1 Calibration

A model period corresponds to one year. The discount rate ρ is set to 0.96. The capital depreciation rate is $\delta = 0.10$. The span-of-control parameter is set to 0.85 as in Restuccia and Rogerson (2008) and implies that profits constitute 15 percent of income. The exogenous exit rate is set to 10%.[16] The wage is the numéraire. We set the 1967 corporate tax rate to $\tau = 40\%$ as in Gravelle (2004). These parameter choices are summarized in Table 3.

Parameter	Value	Target
δ	0.10	Depreciation Rate
γ	0.85	Span of Control
x	0.10	Exit Rate, Census BDS
ρ	0.96	Real rate of return $r = 4\%$
w	1	Numéraire
τ_{1967}	0.40	Corporate Income Tax in 1967
τ_{1954}	0.50	Corporate Income Tax in 1954
τ_{2012}	0.20	Corporate Income Tax in 2014

Table 3: Calibration Summary: Preset Parameters

The remaining four parameters are calibrated jointly to match four key moments that represent the joint distributions of employment, value added, and labor intensities in the industry. While these moments are identified jointly, we provide below a heuristic discussion of the intuition for

[15]The statutory rate in 1954 was 52%. The highest effective corporate tax rate was 63% in 1953.

[16]There is a well-documented decline in the rate of firm entry and exit over time which this version of the model with exogenous exit cannot generate. The exogenous exit rate we chose comes from the U.S. Census' Business Dynamics Statistics manufacturing data between 1977 and 2004.

the identification of the model parameters. The estimated parameter values are shown in Table 4.

The first two parameters determine the heterogeneity in firm-specific productivity ε, which in turn affects the employment size distribution in the industry. We use the average establishment size (number of employees) and an employment concentration measure from the 1967 Census of Manufacturing as targets for the mean and the variance of (log) ε. Specifically, we target the fraction of employment in establishments with more than 250 employees.[17]

To calibrate the distribution of labor shares across firms in 1967, we follow the empirical evidence in Kehrig and Vincent (2018) and assume that labor shares β follow a symmetric triangular distribution across firms. This distribution is characterized by two parameters, an upper and a lower bound. Because β cannot exceed γ, the latter determines the upper bound. The lower bound, $\underline{\beta}$, is calibrated by targeting the manufacturing labor share in 1967, which was equal to 53.9% according to the Annual Survey of Manufacturers (ASM).

Finally, to pin down the entry cost c_e, we use a concentration measure from the joint distribution of manufacturing labor shares and value added. Specifically, we target the ratio of the value added (VA) weighted median labor share to the unweighted median labor share.[18] A ratio of one corresponds to a symmetric distribution of value added over firms with different labor intensities. Ratios below one represent an output distribution biased towards capital intensive firms. This ratio, which we denote by Λ, was equal to 0.886 in 1967, implying only a modest amount of concentration of value added in establishments that have below-median labor shares. From the free-entry condition (4), the value of c_e determines the price of the industry's output p. As we showed above, changes in the equilibrium price p in turn determine the real effective wage rate for the industry, w/p, and thereby the distribution of output over firms with different labor intensities. That is how c_e identifies the targeted moment.

The resulting estimates and a comparison between data and model moments is shown in Table

[17] The Census BDS data and the Census of Manufacturing report employment in various size-class bins. In 1967, establishments with 250+ employees constitute the largest 4.25% of all establishments and represent 60.05% of total employment. Below we compute Pareto indices to facilitate the comparison of concentration measure across time.

[18] The median value added weighted labor share says that 50% of all value added is produced by establishments with a labor share lower than or equal to this value. This moment is taken from Kehrig and Vincent (2018).

Parameter	Value	Targets from 1967	Data	Model
μ_ε	0.562	Average Establishment Size	60.5	60.5
σ_ε	0.290	Employment share of large establishments (250+)	0.60	0.60
β	0.252	Manufacturing labor share	0.54	0.54
$\underline{c_e}$	50.77	VA-weighted p50(LS) / median(LS)	0.89	0.89

Table 4: Calibration Summary: Jointly Identified Parameters

Data: 1967					
Establisment Size:	<20	20-99	100-249	250-999	1,000+
Establishments	65.0	24.2	6.5	3.6	0.7
Employment	5.6	17.7	16.6	27.3	32.8
Value Added	5.1	14.9	14.9	27.1	38.0
Calibrated Model					
Establisment Size:	<20	20-99	100-249	250-999	1,000+
Establishments	65.8	23.3	6.8	3.4	0.8
Employment	5.9	16.9	17.3	26.3	33.6
Value Added	6.1	17.3	17.7	26.1	32.8

Table 5: Distributions - Data vs. model

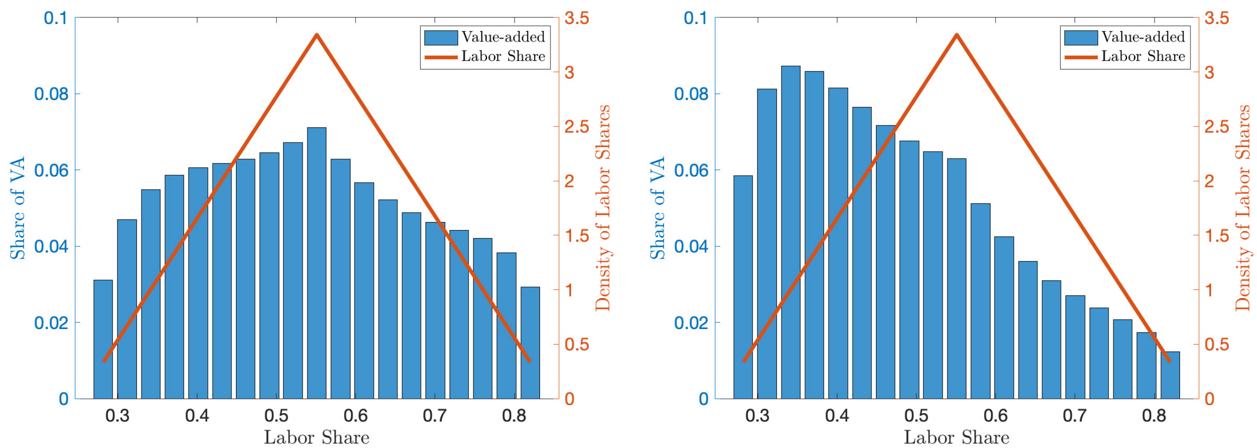
4.[19] Table 5 shows the implied distributions of establishments, employment and value added across production sites, together with the corresponding data from the manufacturing sector reported in the 1967 Statistical Abstract of the United States. Even though only the average establishment size and one employment concentration moment were targeted, the model matches all three distributions very well. Both the share of establishments in the various size bins, as well as their share of total employment and value added are very close to their empirical counterparts.

The joint distribution of value added and labor shares in the model economy is shown in Panel a) of Figure 5. The distribution of value added does not show any significant signs of asymmetry, as captured by the ratio of the median value added weighted labor share and the median labor share discussed above.

[19]The resulting unweighted percentage distance between the data and model moments is 0.342%.

Figure 5: Joint Distribution of Labor Shares and Value Added.

(a) Benchmark Economy, $\tau = 40\%$ (b) Lower Corporate Tax Rate $\tau = 20\%$



Notes.– The figures show distributions of value added (blue bars, left axes) and firm-level labor shares (red line, right axes). Panel a) shows the calibrated benchmark economy. Panel b) shows the economy with a corporate tax rate to 20%.

Overall, the model does a good job of capturing salient features of the 1967 economy. We find this encouraging as it indicates that the model provides an appropriate framework to study the macroeconomic implications of the changes in the corporate taxes, which we turn to next.

5.2 Corporate Tax Cuts and the Labor Share

We now consider a fall in the corporate tax rate τ from a level of 50%, observed in 1954, to the 20% observed in 2014. Our results are summarized in Table 6. The key finding is that a decrease in the corporate tax rate from 50% to 20% results in a decline in the labor share from 57.6% to 47.9%, i.e. a decline of 9.7pps. The labor share in US manufacturing fell from 60.4% in 1954 to 33.5% in 2014, implying that corporate tax cuts explain 36% of the total decline of the manufacturing labor share between 1954 and 2012.

The aggregate labor share falls because of two interacting forces. First, the decrease in τ directly lowers the cost of capital. Building on our analysis in Section 4, this disproportionately benefits firms with a high capital share. These firms are using the factor whose relative cost is

Year	Model Simulation 1967	1954	2014	Data 1967	1954	2014
Corp. tax rate (τ)	0.40	0.50	0.20	0.40	0.50	0.20
Labor share	0.54	0.58	0.48	0.54	0.60	0.34
Median LS ratio Λ	0.89	1.22	0.67	0.89	-	0.44
Inverse Pareto Index (250+)	0.84	0.87	0.81	0.84	0.84	0.77
Inverse Pareto Index (1000+)	0.77	0.80	0.74	0.78	0.77	0.69
Average Establishment Size	60.5	87.7	32.5	60.5	54.5	44.4
Price Level p	1.00	1.13	0.80	-	-	-
Cost of capital r_τ	1.00	1.15	0.82	-	-	-

Table 6: Policy experiment - A drop in corporate Taxes

Note.– Price level and cost of capital have been normalized to one in the 1967 benchmark economy. The 'Data' columns use ASM and BDS data. The labor share ratio Λ is the VA-weighted median divided by the unweighted median labor share. Data for the VA-weighted labor share moment is taken from Kehrig and Vincent (2018) and corresponds to the year 2012. This moment is unavailable in 1954.

declining more intensely. This generates a shift of the value added distribution towards more capital-intensive firms. As more output is produced in low labor share firms, the aggregate labor share falls and the concentration of value added increases. Second, the lower tax rate encourages entry into the sector and reduces the price level. This raises the effective real wage for the industry, causing a further reallocation of value added towards capital intensive firms and hence a further decline in the aggregate labor share.

Table 7 decomposes the decline in the labor share into those two components. In our simulations, holding the price level constant while lowering the corporate tax rate to 20% reduces the labor share by 5.0pp. Keeping the corporate income tax fixed at 50% but decreasing the price level to the level obtained following the reduction of τ to 20% above leads to another 5.0pp reduction in the labor share.

The extent of the reallocation of value added across the labor share distribution is summarized by Λ, the ratio of the median value added weighted labor share to the median unweighted labor share in row three of Table 6. This moment decreases to 0.674 under the simulated lower corporate tax rate. It is 0.44 in the data towards the end of our sample period. In panel b) of Figure 5 we illustrate the change in the joint distribution of labor shares and value added following the decrease

Effect	Change in Labor Share
Lower corporate tax rate, no price effect	-4.95pp
Unchanged corporate tax rate, lower price	-5.03pp
Joint effect	-9.70pp

Table 7: Decomposing the Decline in the Labor Share
Note.– Decomposition of the decline in the aggregate labor share of going from a corporate tax rate of 50% to 20%.

in the corporate income tax to 20%. While the unweighted labor share is constant, the distribution of value added shifts towards low labor share firms. Following the decrease in taxes, the median value added weighted labor share drops from 49.1% to 37.1%. These results are in line with recent empirical findings by Autor et al. (2017) and Kehrig and Vincent (2018), who show that declining industry-level labor shares were accompanied by a concentration of market shares among capital intensive firms.

5.3 Implications for Employment Concentration

Rows four to six of Table 6 show the effects of the lower tax rate on employment concentration and average establishment size. To facilitate the comparison of employment concentration measures across time, we compute the implied (inverse) Pareto index at various points of the employment distribution. The Pareto index relates the share of firms above a certain size to their share of total employment. The inverse of this index is increasing in concentration.

An interesting result is that while the model generates an increase in the concentration of value added, it predicts a *decrease* in employment concentration. The reason for this result lies in the heterogeneity of firms' factor intensities. Because the firms that capture a larger share of the market are primarily capital intensive, they require less labor to operate for a given level of output. As the industry moves from a traditional labor intensive structure to a capital-intensive structure, the correlation between labor intensity and market share declines. Labor intensive firms, initially among the largest employers, shrink both in terms of output and employment. As a result, the concentration of employment decreases and average employment falls.

These predictions regarding the employment distribution are in line with the data. The 2014 'Data' column in Table 6 shows a lower average size along with a decrease in employment concentration in the US manufacturing sector. A more detailed comparison between the employment distributions in the simulated 2014 economy and the data reveals a good fit of the 2014 establishment and employment distributions, shown in Table 8. While these moments were not explicitly targeted in the model calibration, the model is nevertheless able to generate the large reallocation of employment towards small firms that we see in the data. The slight over-prediction of this trend leads to a counterfactually large decrease in average establishment size. This is not surprising given that the model abstracts from technological progress. An increase in aggregate TFP would raise the average establishment size in our model, mitigating the fall implied by rising market share of capital intensive firms. Despite this shortcoming, the model is able to capture the massive decrease in employment in the largest firms as a share of total manufacturing employment between 1967 and 2014 - from 32.8% to 17.3%.

Data: 2014					
Establisment Size:	<20	20-99	100-249	250-999	1,000+
Establishments	67.1	23.6	6.1	2.8	0.4
Employment	9.5	23.7	21.2	28.2	17.3
Model					
Establisment Size:	<20	20-99	100-249	250-999	1,000+
Establishments	77.2	16.7	4.0	1.8	0.3
Employment	10.9	22.3	18.5	25.1	23.1

Table 8: Employment Distribution: 2014 BDS Data vs. model simulation

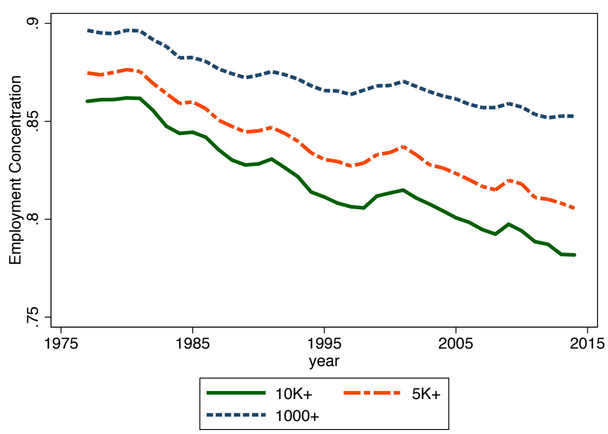
This reallocation of employment towards small firms drives the decrease of employment concentration. The model under-predicts this decrease compared to the data, just as it explains only a part of the decline in the labor share. Further reductions in the relative cost of capital would bring the predictions of the model closer to the data. This could be, for instance, due to a decline in the relative price of investment goods in the economy (as analyzed in Gordon (1990) and

Karabarbounis and Neiman (2013)).

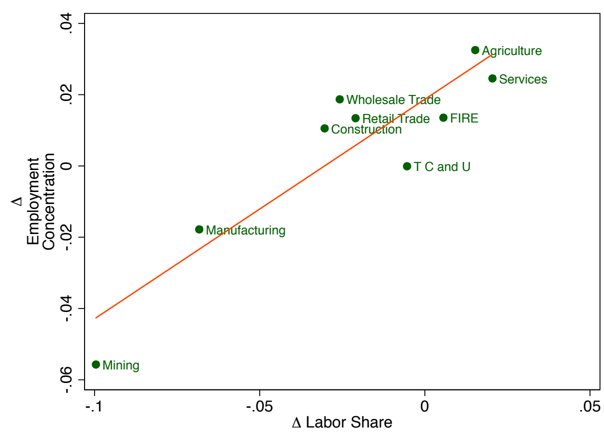
Our results regarding employment concentration extend more generally to traditionally labor-intensive sectors, where the rise in market concentration was not accompanied by a rise in employment concentration. In panel a) of Figure 6 we show the inverse Pareto indices implied by the employment shares of large manufacturing firms. We see a steady decline in employment concentration since 1977, the first year available in the BDS data.[20] Panel b) shows the estimated linear trends in employment concentration together with changes in the payroll share for major industry groups between 1987 and 2014. The figure shows that there has been a significant decline in employment concentration in the manufacturing and mining sectors, the two industries where the labor share has fallen the most.

Figure 6: Trends in Employment Concentration and Payroll Share: 1987 - 2014

(a) Manufacturing Employment Concentration



(b) Employment Concentration and Labor Share



Note.– Concentration is defined by the inverse of the Pareto index implied by the share of employment among the largest firms. Letting s_x denote the share of firms with more than x employees, and e_x their share in total employment, the Pareto index is computed by $\iota_P = \log s_x / (\log s_x - \log e_x)$. The left graph shows the concentration among firms with more than 1,000, 5,000, and 10,000 employees. The right graph shows the estimated trends in employment concentration against the trend in the payroll share for major industry groups between 1987 and 2014. Sources: BDS and BLS.

The result that lower corporate tax rates lead to a higher value added concentration and a lower employment concentration is not trivial and was not targeted during the calibration of our model.

[20]Figure 10 in Appendix A.1 shows that these patterns are robust to computing employment concentration at the establishment level for the period 1954-2014.

We see this as a validation of our proposed mechanism. It should be noted that this prediction of the model depends on the initial employment size distribution. If employment is initially concentrated among labor intensive firms - as in the case in the manufacturing sector - then lower taxes can be expected to reduce employment concentration. However, further declines in the corporate tax rate, may have a limited effect on employment concentration.

6 Discussion

The key mechanism in our model is a drop in the relative cost of capital induced by the lower tax rate. Other theories that are based on changes in relative factor prices, for instance due to a fall in the price of investment goods (Karabarbounis and Neiman, 2013) would operate in a way that is qualitatively similar to a fall in the tax rate. Quantitatively, the impact would be smaller for a given change in the relative prices. This is because a fall in the tax rate raises net-of-tax profits in addition to lowering the price of capital. This results in a stronger equilibrium effect than implied by the change in the price of capital alone.

Changes in the degree of competition in the economy have been proposed as another reason for the decline of the labor share. De Loecker and Eeckhout (2017) document an increase in markups and profits since the 1980s. They argue that the increase in markups - due to diminished competitive pressure - has contributed to the decline of the labor share. Autor et al. (2017) on the other hand, argue that an increase in competition due to a higher price elasticity of demand has resulted in the concentration of market share among capital intensive firms.

While these theories can be generally thought of as complementary to our mechanism, we can nevertheless use the structure of our model to assess the consequences of changes in the market structure - absent any changes in corporate taxation - on the labor share and firm size distribution in an industry. To that end, we return to the 1954 version of the model for the manufacturing sector, i.e. the high-labor share, high-tax economy, and simulate these changes. In our model, both changes in markups, and a higher price elasticity of demand can be represented through changes in the span of control parameter γ.

To analyze the implications of higher markups, we lower γ from 0.85 to 0.82, which is equivalent to an increase in markups from 17.6% to 22%. The column 'Higher Markups' in Table 9 compares the resulting moments to our benchmark 1954 economy. Perhaps surprisingly, the model predicts an *increase* in the industry labor share. Higher markups decrease the optimal output level for all firms and raise the price level. This lowers the effective real wage and favors labor intensive firms. In equilibrium, value added shifts towards labor intensive firms and limits the direct impact of higher markups on the industry's labor share in the context of our model.

Moment	Benchmark	Higher Markups	More Competition
Aggregate labor share	0.58	0.59	0.51
Median LS ratio Λ	1.22	1.26	0.72
Inverse Pareto Index (250+)	0.87	0.82	0.92
Inverse Pareto Index (1000+)	0.80	0.75	0.87
Average Establishment Size	87.7	102.0	66.6
Price Level p	1.00	1.55	0.77
Cost of capital r_τ	1.00	1.00	1.00

Table 9: Markups, Price Elasticity and the Labor Share

Note.– The table shows key moments from model simulations with different values of γ and for a change in the investment price. For the results in column 'Higher Markups' we set $\gamma = 0.82$. For the results in column 'More Competition' we set $\gamma = 0.88$. The labor share ratio Λ is the VA-weighted median divided by the unweighted median labor share. The corporate tax rate was $\tau = 0.50$ for these experiments. The price level and the cost of capital have been normalized in the column 'Benchmark'.

An increase in the price elasticity of demand is represented by an increase in γ. The column 'More Competition' in Table 9 shows the resulting moments of an economy in which $\gamma = 0.88$. The higher γ increases firm value and fosters entry into the industry, resulting in a lower price level. This, in turn, raises the real wage and shifts production away from labor-intensive firms. Note that the increase in γ also increases the elasticity of output with respect to prices (*cf.* (7)). This exacerbates the shift in production towards capital-intensive firms. The resulting economy has a labor share that is similar to the value resulting from lower corporate taxes. However, Table 9 also reveals that a higher price elasticity of demand brings about a significant increase in employment concentration among the largest firms, a pattern that is at odds with the manufacturing sector.

7 Conclusion

Our findings highlight the role of an institutional factor, corporate taxation, for the global decline of the labor share. Our results suggest that the observed decline in the labor share is partly episodic, and should slow down when further tax cuts are no longer feasible. They also suggest that the decline of the labor share is partly reversible, should policymakers decide to do so.

Recent legislation brought significant changes to the business taxes in the US, including a drop in the statutory corporate tax rate from 35 percent to 21 percent. While it is early to fully determine the new effective marginal tax rate on capital investment, the labor share can be expected to decrease further. Our simulations indicate that the complete elimination of corporate taxes decreases the labor share to 44%, an additional four percentage point decline starting from the model's implied 2014 values.

While our paper focused on corporate taxation, labor taxation can be equally important. The main taxes on labor in US are the individual income tax and payroll taxes. The average individual income tax has been more or less stable in the US. Payroll taxes, on the other hand, have increased significantly during the 1960s and 1970s, following the formation and expansion of the federal social security system and Medicare. Piketty and Saez (2007) report the average income and payroll tax rates between 1960 and 2001. The total rate increased from 14.9 percent to 22.9 percent, implying a 10.4 percent increase in the effective wage rate. Higher taxes on labor would reduce the labor share in our model in a way that is similar to corporate tax cuts. The model simulations predict a decline in the manufacturing labor share of 15pp in response to changes in corporate and labor taxes combined, an additional drop of 4.5pp attributable to labor taxes alone.

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A Data Appendix

The OECD and KLEMS data used in Section 2.1 was collected from the following sources. Data on labor shares comes from the World KLEMS website (`worldklems.net`). We used the 2011 update of the November 2009 release of the EU KLEMS database. Later releases do not include observations before 1996. We added to this the KLEMS data for Canada.

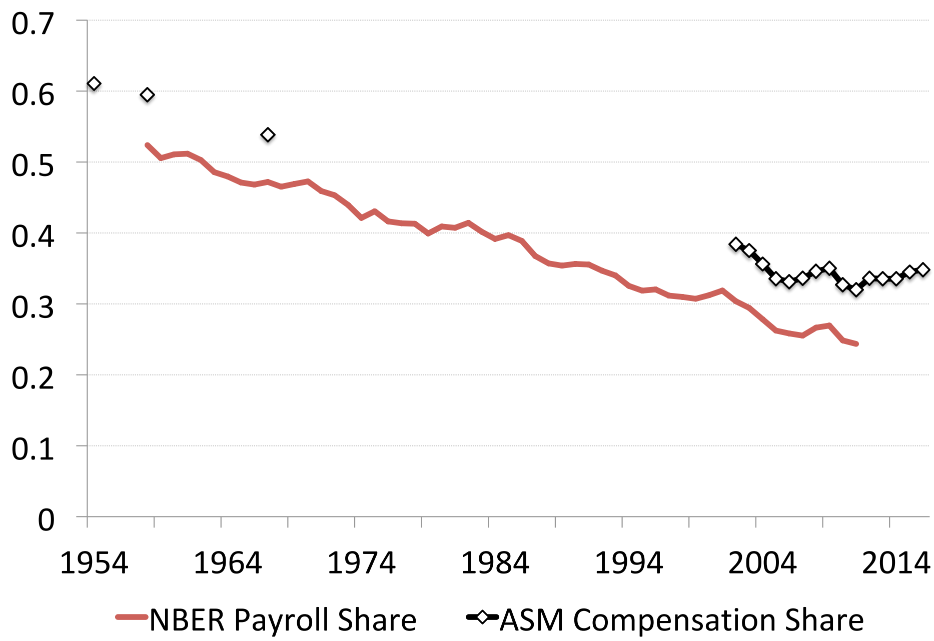
Manufacturing is defined by the ”Total Manufacturing Sector”. Services are the sum of electricity, gas and water supply, wholesale and retail trade, hotels and restaurants, transport and storage and communication, financial intermediation, and real estate, renting and business activities. The aggregate labor share is computed as the sum of all sectors.

The pre-2000 OECD data on corporate tax rates was collected from Table II.1 at `http://www.oecd.org/tax/tax-policy/tax-database.htm#C_CorporateCapital`. The post-2000 data comes from from Table II.1 at `https://stats.oecd.org/index.aspx?DataSetCode=Table_II1%20`. We used the basic combined central and sub-central (statutory) corporate income tax rate given by the adjusted central government rate plus the sub-central rate.

The US state-level data used Section 2.2 comes from the Annual Survey of Manufactures 1972 - 2012 (labor shares), the BEA (unemployment rates), and Suárez Serrato and Zidar (2016) (income from corporate taxation). State-level corporate tax rate denote the average corporate tax rate in a state. We focus on mainland US states, i.e. we exclude Alaska and Hawaii.

The payroll share in manufacturing in 1967 was 53.9% according to the Annual Survey of Manufacturers (ASM). The payroll share is the sum of total wage payments plus fringe benefits over value added. Payroll is defined as gross earnings paid to all employees on the payroll of operating manufacturing establishments. Employees comprise all full-time and part-time employees. Employees in administrative offices and auxiliary units is included. Employment in central administration, such as corporate headquarters as well as proprietors and partners, is excluded. Payroll figures include all forms of compensation such as salaries, wages, social security contributions, bonuses, etc. To this we add fringe benefits such as contributions for private pension plans and

Figure 7: Payroll Share in Manufacturing



health insurance. Data on fringe benefits is available for 2014. For 1954 we impute fringe benefits using data for 1967. The benefit share of value added was 5.7% in that year. Figure 7 shows the resulting total share of compensation in value added for various years and compares it with the payroll share computed from the NBER manufacturing database.

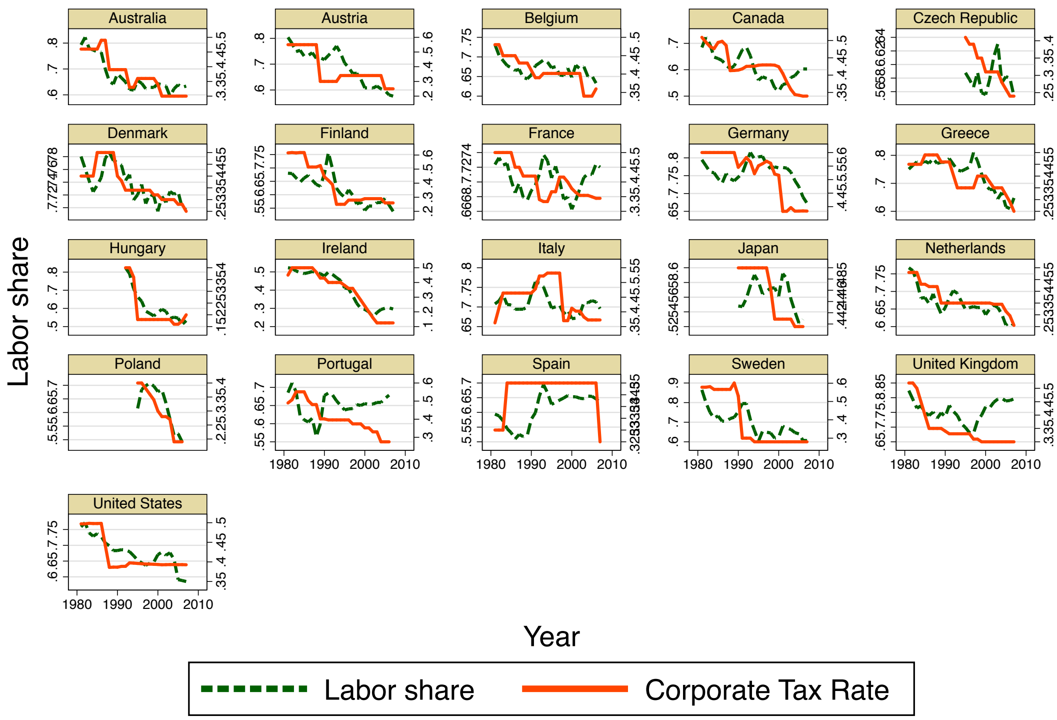
A.1 Additional Results and Sensitivity

Trends in country-level statutory corporate tax rates together with manufacturing labor shares are shown in Figure 8 for the countries in our sample. Countries with short panels (Estonia, Korea, Latvia, Lithuania, Luxembourg, Slovenia, Slovakia) were excluded from the Figure. These countries are included in the analysis in Section 2.1. Excluding them from our regressions does not affect our results.

Trends in state-level effective corporate tax rates together with manufacturing payroll shares are shown in Figure 9.

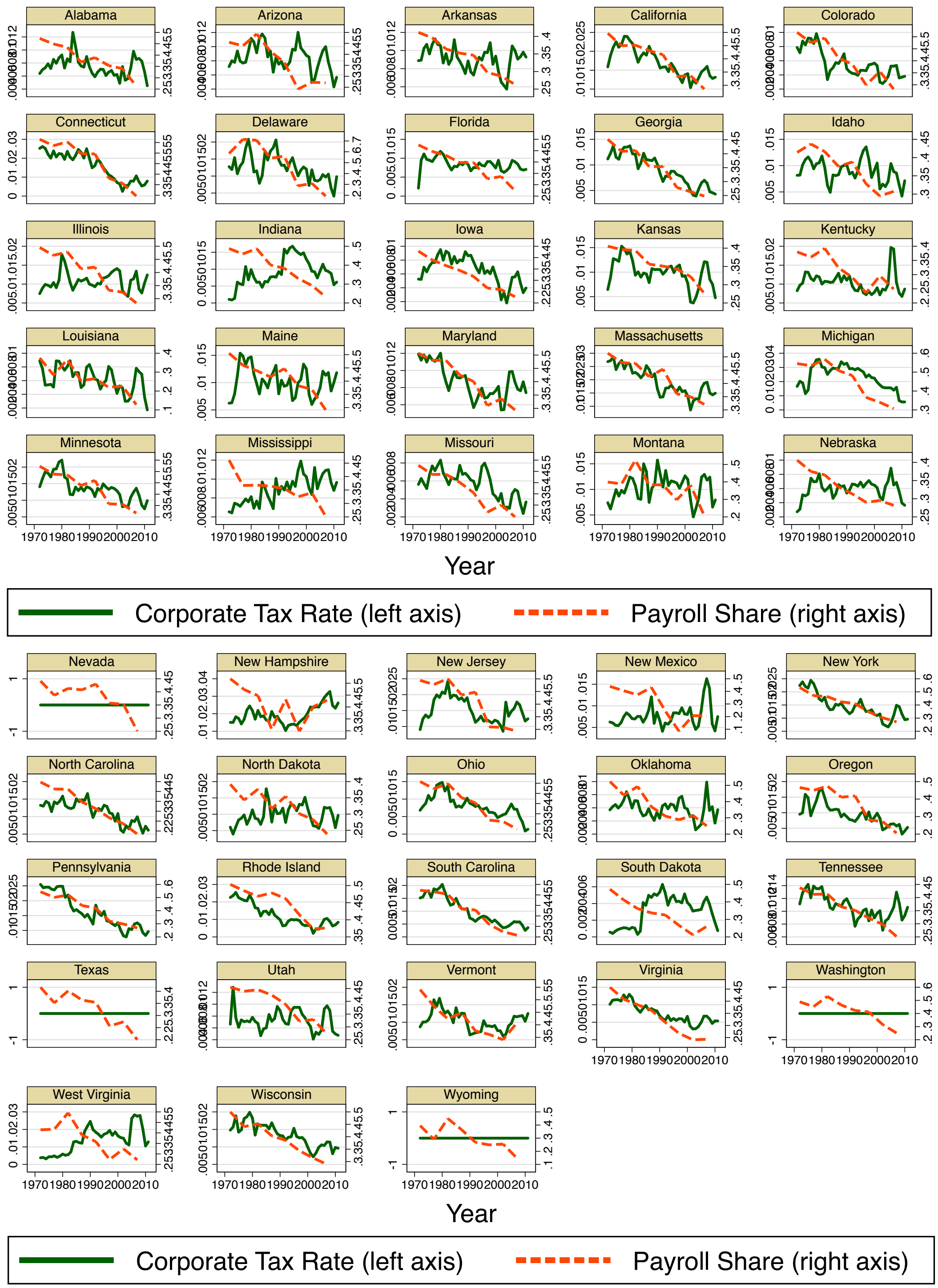
Figure 10 shows the trend in manufacturing employment concentration at the establishment

Figure 8: Trends in Statutory Corporate Tax Rates and Labor Shares by Country



Note.– Data shows trends in statutory corporate tax rate and labor's share of income in the manufacturing sector for each country. Corporate tax rates are shown on the right y-axis. Source: OECD and KLEMS.

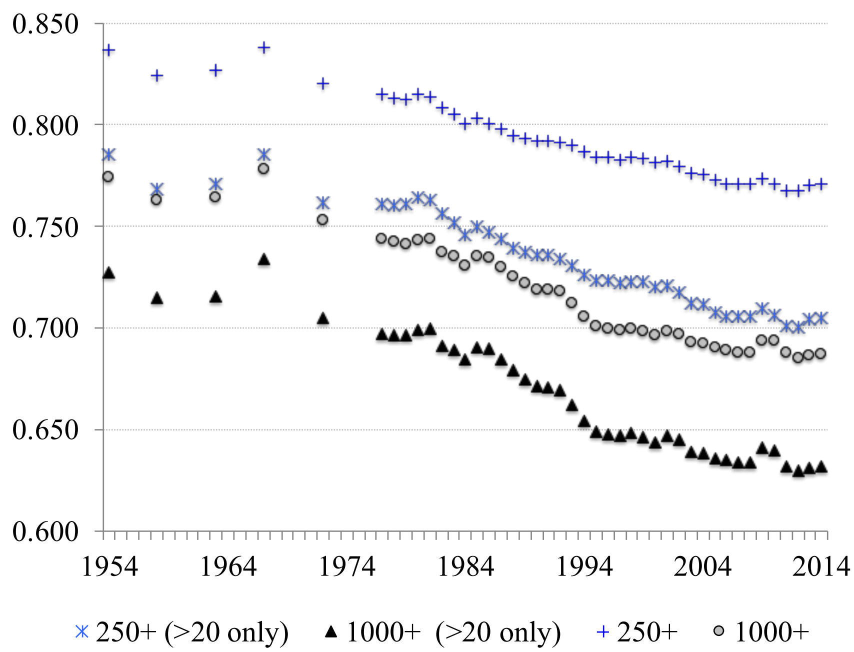
Figure 9: Trends in Effective Corporate Tax Rates by State



Note.– Effective tax rates are calculated as the ratio of total corporate tax revenue and gross operating surplus in a state and are taken from Suárez Serrato and Zidar (2016).

level. We supplement the Census' BDS data, available starting in 1977, with establishment-level data from the quinquennial Census of Manufacturers for the years 1954-1972. Compared to panel a) of Figure 6 in the main text, the trend in manufacturing establishment-level employment concentration mirrors that of firm-level concentration. Conditioning the concentration measures to establishments with at least 20 employees does not change the patterns.

Figure 10: Trends in Manufacturing Employment Concentration - Establishments



Note.– Concentration is defined by the inverse of the Pareto index implied by the share of employment among the largest establishments. Letting s_x denote the share of establishments with more than x employees, and e_x their share in total employment, the Pareto index is computed by $\iota_P = \log s_x / (\log s_x - \log e_x)$. The graph shows the concentration among establishments with more than 250 and 1000 employees. The lines labeled (> 20) only show the respective indices conditioning on establishments with at least 20 employees. Sources: BDS and Census of Manufacturers.

B Proofs

From (2) the first order conditions for labor and capital demand are:

$$\bar{w} \equiv \frac{w}{p} = \beta k^{\alpha} n^{\beta-1} \tag{A.10}$$

$$r_{\tau} \equiv \frac{1-\tilde{\rho}}{\tilde{\rho}\cdot(1-\tau)} + \delta = \alpha k^{\alpha-1} n^{\beta} \tag{A.11}$$

The statement from the main text, that for a given level of capital demand, labor demand is undistorted by the corporate tax rate, follows from (A.10). On the other hand, (A.11) shows that the presence of corporate taxes directly affects capital demand by increasing the effective cost of capital r_{τ}.

With firm output evaluated at the optimal labor and capital demand given by (6), the output elasticity of the real wage $\bar{w}$ is $\eta_{q,\bar{w}} = \frac{d\log q}{d\log \bar{w}} = -\frac{\beta}{1-\gamma}$, whereas $\eta_{q,r_{\tau}} = \frac{d\log q}{d\log r_{\tau}} = -\frac{\alpha}{1-\gamma}$, as was stated in (7) in the main text.

Proof of Lemma 1

Proof. Let $Q = \int q(\alpha)dG(\alpha)$ denote aggregate output. From (9), the elasticity of $\lambda(\alpha)$ w.r.t. a factor price x is $\eta_{\lambda,x} = \eta_{q,x} - \eta_{Q,x}$. The elasticity of aggregate output is $\eta_{Q} = \frac{dQ}{dx}\frac{x}{Q} = \int \frac{dq}{dx}\frac{x}{Q}dG(\alpha) = \int \eta_{q,x}\frac{q}{Q}dG(\alpha)$. It follows that $\eta_{\lambda,x} = \eta_{q,x} - \int \eta_{q,x}\frac{q}{Q}dG(\alpha)$. The Lemma then follows by replacing $\eta_{\lambda,x}$ with their definitions in (7) and the definitions of $\hat{\beta}$ and $\hat{\alpha}$. For example, to compute the elasticity with respect to the cost of capital, these steps yield $\eta_{\lambda,r_{\tau}} = -\frac{\alpha}{1-\gamma} + \int \frac{\alpha}{1-\gamma}\frac{q}{Q}dG(\alpha) = -\frac{\alpha-\hat{\alpha}}{1-\gamma}$. ■

Proof of Proposition 2

The proof follows from combining Lemma 1 with the free-entry condition (4). Because the entry cost is constant, a drop in firm value caused by higher taxes has to be matched with an increase in the price level to ensure that the free entry condition holds.

Proof of Proposition 1

Proof. Following a change in factor price x, the change in the aggregate capital share is given by $\frac{d\hat{\alpha}}{dx} = \int \frac{d\lambda(\alpha)}{dx}\alpha dG(\alpha) = \frac{1}{x}\int \eta_{\lambda,x}\lambda(\alpha)\alpha dG(\alpha)$. Using $\int \eta_{\lambda,x}$ from Lemma 1, we obtain

$$\frac{d\hat{\alpha}}{dr_\tau} = -\int \frac{(\alpha-\hat{\alpha})\,\lambda(\alpha)\alpha dG(\alpha)}{r_\tau(1-\gamma)} = -\frac{\int \lambda(\alpha)\alpha^2 dG(\alpha) - \hat{\alpha}\int \lambda(\alpha)\alpha dG(\alpha)}{r_\tau(1-\gamma)} = \frac{-\sigma_\alpha^2}{r_\tau(1-\gamma)}.$$

It follows that $-\frac{d\hat{\alpha}}{dr_\tau}r_\tau = \frac{\sigma_\alpha^2}{1-\gamma}$. The proof for the real wage rate is similar. ■

Proof of Lemma 2

Proof. The firm's value function (2), evaluated at optimal factor demands, is:

$$V(\alpha) = \frac{\hat{\rho}}{1-\hat{\rho}}\cdot(1-\tau)(1-\gamma)\cdot\left(p^{1-\alpha}\left(\frac{\alpha}{r_\tau}\right)^{\alpha}\left(\frac{\beta}{w}\right)^{\beta}\right)^{\frac{1}{1-\gamma}}. \tag{A.12}$$

Because $c_f = 0$, $V(\alpha) > 0$. The elasticity of the value function with respect to τ is $\eta_{V,\tau} = -\frac{1}{1-\tau} - \frac{\alpha}{1-\gamma}\frac{1-\hat{\rho}}{r_\tau\hat{\rho}(1-\tau)^2} < 0$. This implies that $\frac{\partial V(\alpha)}{\partial\tau} \leq 0$ for all $\tau \geq 0$ and for all $\alpha \in [0,\gamma]$, with strict inequality whenever $\alpha > 0$. Therefore, $\frac{\partial \mathbb{E}V(\alpha)}{\partial\tau} < 0$. Similarly, given an elasticity $\eta_{V,p} = \frac{1-\alpha}{1-\gamma}$ we have $\frac{\partial V(\alpha)}{\partial p} = \frac{1-\alpha}{1-\gamma}\frac{V(\alpha)}{p} > 0$ for all $p > 0$ fand $\alpha \in [0,\gamma]$. Hence, $\frac{\partial \mathbb{E}V(\alpha)}{\partial p} > 0$, implying that $dp/d\tau|_{\mathbb{E}V=c_e} > 0$ ■

Proof of Proposition 3

Proof. Using the first two propositions, the derivative of $\hat{\beta}$ with respect to $(1-\tau)$ is:

$$\frac{d\hat{\beta}}{d(1-\tau)} = \left(\frac{d\hat{\beta}}{d\bar{w}}\frac{d\bar{w}}{dr_\tau} + \frac{d\hat{\beta}}{dr_\tau}\right)\frac{dr_\tau}{d(1-\tau)} = \frac{\sigma_\alpha^2}{1-\gamma}\left(1-\eta_{\bar{w},r}\right)\frac{1}{r}\frac{dr_\tau}{d(1-\tau)}, \tag{A.13}$$

where $\eta_{\bar{w},r}$ denotes the elasticity of the equilibrium real wage rate with respect to the rental rate of capital as implied by the entry condition. Using the value function in (A.12), the free entry condition (3) can be expressed as

$$(r_\tau - \delta)c_e = (1-\gamma)\int q(r_\tau, \bar{w}|\alpha)dG(\alpha),$$

where $q(\cdot)$ is the optimal output function defined in equation (6). Taking the derivative of both sides with respect r_τ, we obtain:

$$c_e = (1-\gamma)\int\left(\frac{dq}{dr_\tau} + \frac{dq}{d\bar{w}}\frac{d\bar{w}}{dr_\tau}\right) = \frac{(1-\gamma)}{r}\int\left(r_\tau\frac{dq}{dr_\tau} + \bar{w}\frac{dq}{d\bar{w}}\eta_{\bar{w},r_\tau}\right) \tag{A.14}$$

All integrals are taken over $dG(\alpha)$. Given the output elasticities in (7), the derivatives of output w.r.t. factor prices are:

$$\frac{dq}{dr_\tau} = -\frac{\alpha}{1-\gamma}\frac{q}{r_\tau} \quad \text{and} \quad \frac{dq}{d\bar{w}} = -\frac{\beta}{1-\gamma}\frac{q}{\bar{w}}$$

Substituting these in equation (A.14) and rearranging terms gives:

$$rc_e = -\int(\alpha + \beta\eta_{\bar{w},r_\tau})q = -\gamma\int q + (1-\eta_{\bar{w},r_\tau})\int\beta q$$

Dividing both sides by $\int q$ gives:

$$\frac{rc_e}{\int q} = -\gamma + (1-\eta_{\bar{w},r_\tau})\underbrace{\int\frac{q}{\int q}\beta}_{\hat{\beta}}$$

Finally, substituting for c_e from the free entry condition and rearranging the terms gives the elasticity of real wage w.r.t. the rental rate.

$$(1-\eta_{\bar{w},r_\tau}) = \frac{1}{\hat{\beta}}\frac{r_\tau - \gamma\delta}{r_\tau - \delta}.$$

Substituting this result back into equation (A.13) gives the desired elasticity. In particular, noting that $dr_\tau/d(1-\tau) = -(r_\tau-\delta)/(1-\tau)$ from the definition of the user cost of capital, we have:

$$\frac{d\hat{\beta}}{d(1-\tau)} = -\frac{\sigma_\alpha^2}{1-\gamma}\frac{1}{\hat{\beta}}\frac{r_\tau-\gamma\delta}{(1-\tau)}\frac{1}{r},$$

which implies

$$\frac{d\hat{\beta}}{d(1-\tau)}\frac{1-\tau}{\hat{\beta}} = -\left(\frac{\sigma_\alpha}{\hat{\beta}}\right)^2\frac{1-\gamma\frac{\delta}{r_\tau}}{1-\gamma}$$

noting that $\sigma_\alpha = \sigma_\beta$ gives the result. ■