Markups, Tobin's *q* and the Declining Labor Share[1]

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Abstract. Increasing markups have recently gained prominence as a leading explanation for the decreasing share of income going to labor. Thus far, however, the analysis has been limited to the US covering only short periods and generally does not control for potentially important confounders. Constructing data for the share of income going to capital and markups based on Tobin's *q* over the period 1870-2018 for 21 advanced countries, this research examines the ability of markups to explain the movements of income shares at medium term frequencies and the tendency for factor income shares to converge toward constants in the long run. We find strong support for the markup hypothesis even when factor-augmenting technological progress, capital deepening, trade openness, and union strength are controlled for.

JEL Classification: E25, E44
Key words: labor's income share, income inequality, Tobin's *q*, markups, pure profit

1. Introduction

The secular decline in the share of income going to labor in the advanced countries since the 1970s has motivated an extensive range of theories purporting to explain the trend, including declining unionization, capital biased technological progress, automation, globalization, reduced economic growth, wealth accumulation, declining real prices of machinery, and rising markups (Acemoglu, 2003; Checchi and Garcia-Penalosa, 2008; Elsby et al., 2013; Karabarbounis and Neiman, 2014; Piketty, 2014; Caballero et al., 2017; Grossman et al., 2017; Acemoglu and Restrepo 2018; Autor et al., 2020; Bengtsson et al., 2020; Aghion et al., 2021; Farber et al., 2021). Recently, the markup hypothesis has gained prominence as a key driver of factor shares as demonstrated by the contributions of Caballero et al. (2017), Eggertsson et al. (2018), Farhi and Gourio (2018), Autor et al. (2020), Barkai (2020); De Loecker et al. (2020), Aghion et al. (2021) and Farber et al. (2021). Earlier contributions stressing the importance of markups include Blanchard (2007) and Phelps (1994). Whilst the explanations vary, the modern literature stresses globalization, technological change, and institutional changes as facilitators of greater market concentration; thereby, giving large firms greater market power. The literature has focused primarily on constructions of data on markup rates for the United States covering short periods.

Constructing data for 20 advanced countries over the period 1870-2018, this research identifies the time-series paths of markups across countries and tests whether the markup hypothesis has general validity, i.e., whether 1) it is has significantly contributed to the historical evolution of labor shares over time and across the advanced countries; and 2) whether it has contributed to the tendency for factor shares to converge to their steady state equilibrium in the long run as predicted by the theories of Blanchard (1997) and Aghion et al. (2021) among others. The cross-country data enables us to control for common factors that influence the evolution of labor shares across the advanced countries,

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such as factor-biased technological progress, globalization, and supply shocks. More importantly, for the markup hypothesis to have general validity, it should be consistent with the movements in the labor share within the 0-1 boundary and the tendency to gravitate towards a constant in the long run.

We approximate the markup ratio by Tobin's *q*, which measures the proportional expected change in discounted earnings in response to an increase in fixed capital stock. Intuitively, Tobin's *q* exceeds one if the capitalized expected earnings per unit of capital exceed the acquisition costs of a unit of capital. Under perfect competition, Tobin's *q* will be driven down to one by incumbents or the entrance of new firms, while under imperfect competition, this process is incomplete. Rognlie (2015), who is probably the first to use the Tobin's *q* method to measure markups, uses the ratio of the stock market capitalization of firms relative their book value for the US. To compute markups, Tobin's *q* method has the distinct advantage over the accounting methods because it capitalizes the effects of all factors that affect profits, such as taxes, tax rebates, innovations, factor-biased technological progress, and creative destruction. More importantly, historical data on net profits are not available for most countries.

In addition to the construction of long historical data, the principal contribution of the paper is to test whether markup theories in an international context are consistent with the time-series movements in labor shares in the long run history while controlling for confounding factors relating to notable theories of labor shares, including unionization, user cost-induced capital deepening, and factor-biased technological progress. Regarding identification, we do not seek to estimate a causal relationship but rather acknowledge that the functional income distribution can be decomposed into markups, the user cost of capital, wage pressures, as well as technology that progresses at the same rate across countries, and, therefore, that the largest source of endogeneity stems from omitted variables (I think these changes make the sentence flow better). Thus, we control for all these factors in the empirical section; factors that are not controlled for in the literature. Whilst this in itself does not provide sufficient evidence to make a definitive causal claim, it nevertheless strengthens the plausibility of the markup theory.

In structuring this paper we begin with an exposition of the relationship between mark-ups and Tobin's *q* implied by theory in Section 2. In Section 3, we describe our data and argue the case for the validity of our approach to estimating Tobin's q. In Sections 4 and 5, we present our empirical results and counterfactual simulations, before we conclude in Section 6.

2. Related literature

Research into increasing markups as being an important factor behind the increase in capital's share has recently gained momentum with the contributions of Caballero et al. (2017), Eggertsson et al. (2018), Farhi and Gourio (2018), Autor et al. (2020), Barkai (2020), De Loecker et al. (2020), and Aghion et al. (2021). In earlier contributions, Bruno and Sachs (1985) and Blanchard (1997) posit that labor shares are driven by interactions between labor demand and supply that determine the share of rent going to labor and capital. The adverse supply shocks in the 1970s, for example, pushed wages in excess of the marginal productivity of labor and reduced the capital shares. Over time, firms reacted by reducing employment, leading to a steady increase in unemployment that consequently increased markups. Furthermore, firms adopted technologies that used less labor and more capital, thus reducing the marginal product of labor at a given ratio of labor and capital.

Using panel data for the US, Autor et al. (2020) show that the share of labor has been reduced by the rise of so-called 'Super-Star Firms'. The technological progress and globalization starting

already in the 1960s have led to increased competition that has driven up the market share of the most productive firms in a given industry. Being highly productive, these firms have high markups and consequently a lower labor share of value added than the firms they are displacing. Whilst Autor et al. (2020) provide some analysis of global trends in concentration, markups, and labor's share, their paper focuses primarily upon developments in the US since 1955.

De Loecker et al. (2020) find a strong secular increase in markups since 1980 and provide econometric evidence of a negative relationship between markups and labor's share amongst US firms, determined by an expanding market share of firms with high markups. Employing the approach of Hall and Jorgenson (1967), Barkai (2020) compiles estimates of capital costs in the United States between 1984 and 2014, and he uses these estimates to calculate a capital cost share of national income, with income remaining unallocated to either this share, or to labor, accruing to capital owners in the form of 'pure profits'. Barkai (2020) documents that increases in the pure profit share can account for the entirety of the decline in labor's share over his sample period 1984-2014, with the capital cost share of income also declining in response to the increase in profits. Aghion et al. (2021) argue that the increasing market concentration and the associated increase in markups can be explained by IT improvements over the approximate period 1995-2005 that allowed the most efficient firms to expand their boundaries. As these firms enjoy higher than normal markups, their increasing market share pushes down the aggregate labor share. After a while, markups eventually fall as the quality leader on a product line is more likely to face a high process efficiency competitor.

Finally, Eggertsson et al. (2018) and Farhi and Gourio (2018) find that increasing pure profits and market risk have been responsible to the recent decline in labor's share. While the underlying force behind the increasing markups is not a part of the model of Eggertsson et al. (2018), they suggest that lax anti-trust enforcement and the technological changes may have been responsible for the increase in industrial concentration, as evidenced by Grullon et al. (2019).

3. Tobin's *q* and the labor shares in the OECD

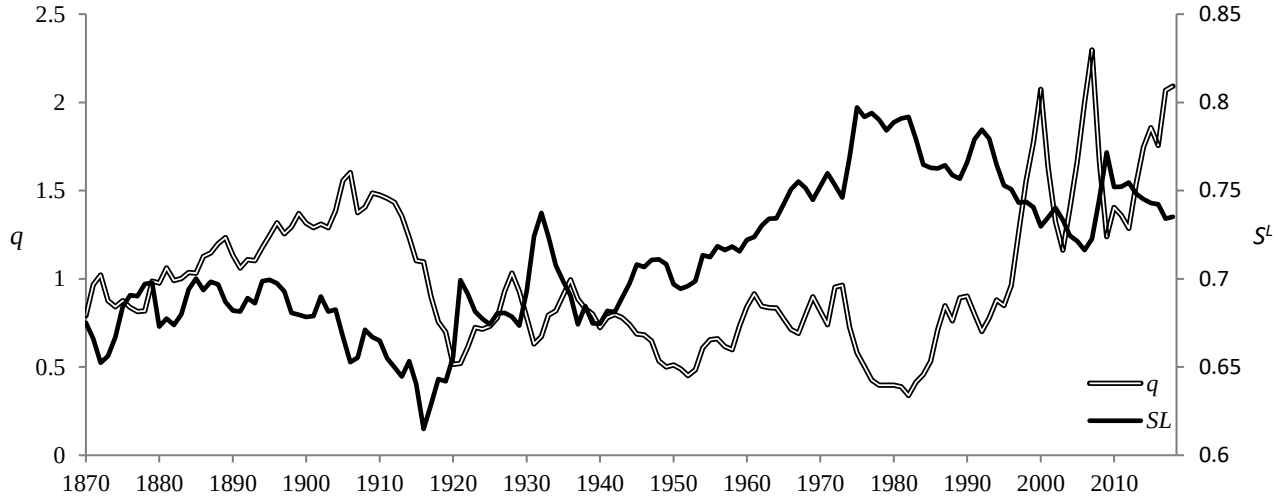
Figure 1 displays Tobin's *q* and the labor share as an unweighted average of the OECD countries over the period 1870-2018, normalized to have a mean of one (see Section 5.2 for the construction of the data). Even without this normalization, Tobin's *q* is known for fluctuating around the benchmark of approximately one, where *q*-values below probably arise because of mismeasurement of the capital stock, such as irreversibility of capital and creative destruction that reduces the value of the existing capital stock beyond normal physical depreciation (see, e.g., Wright, 2004; Solow, 2015).

The figure shows that Tobin's *q* and labor shares fluctuate at medium-term frequencies of 30-40 years duration and that the fluctuations in the labor shares are almost mirror images of *q*. Although the visual impression suggests a significant negative relationship between *q* and the labor share, their causal relationship is masked by other influences, such as globalization, technological progress, and union strength, which need to be accounted for to assess the importance of markups in explaining the path of the labor share.

The periods of increasing *q* coincide somewhat with the globalization waves over the periods 1870-1914 and 1960-2008 (Jacks et al., 2011), technological revolutions over the approximate periods 1870-1914 and since the 1970s (Madsen and Davis, 2006); market deregulations after 1980 (Batra, 1988; Mueller, 1996; Grullon et al., 2019); and reduced union power (Roine et al., 2009; Bengtsson and Waldenström, 2018; Madsen et al., 2018; Farber et al., 2021). The high *q* during the interwar period was associated with deregulation of markets, protection of large national corporations and an

increasing concentration of firms as documented by Batra (1988) and Madsen (2004). It is remarkable how resilient the stock market was to the stock market crash and the subsequent decline in stock prices during the first three year of the Great Depression. Tobin's *q* bounces back to its pre-crash level in the second half of the 1930s.

Figure. 1 Labor's Share and Tobin's *q*



Notes. The data are unweighted averages for the OECD countries. See Section (5.2) for data construction. The data are normalized to a mean of 1. Labor's share is based on GDP net of depreciation of fixed non-residential capital and net of residential housing rent.

Periods of declining *q* have often been associated with increasing union strength, reduced innovative activity, and reduced growth in world trade. The decline in Tobin's *q* during the period 1914-1921 was associated with the abandonment of the Gold Standard at the onset of WWI and its inflationary consequences; a decline that may have been reinforced by the increasing union strength that resulted in large real wage escalations immediately after WWI and the anti-globalization sentiments that evolved during and after WWI **(**Roine et al., 2009**)**. Similarly, the decline in *q* during the 1940s may have been associated with increasing union pressure, and the sharp decline in Tobin's *q* following the oil price shocks in the period 1973-1981, is often attributed to the abandonment of fixed exchange rate regimes, lax monetary policies, and the commodity price shocks that fueled real product wages and accelerated the depreciation of energy intensive capital (see, e.g., Bruno and Sachs, 1985). The coincidence of these multiple events renders it difficult to unmask the underlying reason for the profit-squeeze during these periods.

4. Analytical framework: Mark-ups and Tobin's *q*

We use standard optimal control theory to derive the relationship between markups and Tobin's *q*. Consider the firm's optimization problem (Hayashi, 1982):

$$\boldsymbol{Max\ \Omega = \int_{t=0}^{\infty} e^{-\rho t}\left[P_t A_t K_t^{\alpha} L_t^{1-\alpha} - P_t^I I_t - W_t L_t\right] dt,} \tag{1}$$

s.t.

$$\boldsymbol{\dot{K}_t = \psi(I_t, K_t) - (\delta + g_{\phi}) K_t,} \qquad \boldsymbol{\psi_I' > 0, \psi_I'' > 0, \psi_K' < 0} \tag{2}$$

where Ω is profits, ρ is the required stock return; P is the GDP-deflator; P^I is the price of non-residential investment goods; A is technology; K is the non-residential capital stock; L is employment; I is fixed non-residential investment; W is wages; g_ϕ is the growth in the P/P^K ratio, where P^K is the price of capital; δ is the physical depreciation rate; $\psi(I_t, K_t)$ is convex investment adjustment costs, which implies that I units of gross investment increase capital by less than I and that the cost of the installation of capital is a declining function of the size of the existing fixed capital; and $Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$ is the Cobb-Douglas production function.

The first order conditions (FOCs) for an optimum are (omitting time):

$$
\begin{aligned}
&P(1-1/\eta)\alpha Y/K = \left(\rho + \delta - \psi_K^{'}\right)\lambda - \dot{\lambda}, \\
&\psi_I' = \lambda - 1, \\
&P(1-1/\eta)(1-\alpha)Y/L = W, \\
&\lim_{t\to\infty} \boldsymbol{e^{-\rho t}\lambda, K = 0},
\end{aligned}
\tag{3}
$$

where $\boldsymbol{\lambda}$ is the shadow price of capital, and $\boldsymbol{\eta}$ is the elasticity of demand facing the firm. In steady state, Eq. (3) implies:

$$
\boldsymbol{\lambda = \frac{P(1-1/\eta)\alpha Y/K}{\rho+\delta-\psi_K'}}, \tag{4}
$$

which states that $\boldsymbol{\lambda}$ is the present value of profits accruing from one additional unit of investment. Deflating Eq. (4) by the investment deflator, P^I, we arrive Tobin's q:

$$
q = \frac{\lambda}{P^I} = \frac{P(1-1/\eta)\alpha Y/K}{P^I(\rho+\delta-\psi_K')} = \frac{\mu\alpha YP}{P^I(\rho+\delta-\psi_K')K} = \frac{V}{P^I K}, \tag{5}
$$

which is equal to one under perfect competition in the goods market, $\eta \to \infty$, where μ is markups over marginal costs. In the last term of Eq. (5), the numerator is the value of the firm, which in turn is the capitalized value of future profits, while the denominator is fixed capital at acquisition costs.

A distinct feature of the q-model is that its movements around the long-run equilibrium echoes markups and not technological progress nor changes in taxes in steady state (Summers, 1981; Haysahi, 1982; Madsen and Davis, 2006). Ceteris paribus, an increase in markups is associated with an increase the expected profits per unit of capital and an increase in the capital share. The capital stock is reduced in response to an increase in markups because the benchmark level of q at which investment becomes profitable, has increased. Tax-induced changes in profits have only short-term effects on profits because capital accumulation or decumulation drives the pure profits to zero in the long run. Investment-specific technological progress does not have any overall effect on Tobin's q because the acquisition costs of capital in the denominator of q are unaffected by the technological progress – the decreasing real price of capital is countered by a corresponding increase in the volume of capital. Similarly, the numerator remains unaffected by the technological progress because the profit gain by firms that implement the new technology is countered by the profit loss of firms that do not implement the new technology (for a more general analysis, see Madsen and Davis, 2006).

5. Empirics

5.1. Model specification

The following error-correction model of labor share is estimated for 21 countries using data over the periods 1950-2018 and 1870-2018:

$$\ln S_{it}^{L} = \alpha_0 + \alpha_1 \ln q_{it} + \alpha_2 Union_{it} + \alpha_3 \ln(K/Y)_{it} + \varphi_i t^{Pre} + \omega_i t^{Post} + \varphi_t + \varepsilon_{it}, \quad (6)$$

$$\Delta \ln S_{it}^{L} = \beta_0 + \beta_1 \Delta \ln q_{it} + \beta_2 \Delta Union_{it} + \beta_3 \Delta \ln(K/Y)_{it} + \varphi_i + \varphi_t + \hat{\varepsilon}_{i,t-1} + \nu_{it}, \quad (7)$$

where S^L is the labor share net of residential rent (as detailed in the data section); *Union* is unionization; *K/Y* is the non-residential capital-output ratio; φ_t and φ_i are time and country effects; Δ is a five-year-difference operator; t^{Pre} and t^{Post} are country-specific time-trends (pre-1945 and post-1945); and ε and ν are stochastic error terms. Here, $\hat{\varepsilon}_{i,t-1}$ is an error-correction term lagged one period (five years) from estimates of the cointegration model (Eq. (6)).

The time-dummies capture time-varying global effects that influence all countries simultaneously but that are not captured by *q*, such as factor-biased technological progress, world wars, commodity price shocks, social movements, globalization waves, etc. We estimate Eq. (7) in long differences to filter out cyclical influences. Estimates in 10- and 20-year overlapping first differences are also undertaken. We include a split time-trend before and after WWII in the cointegration equation to allow for a structural shift in the retention ratio, as detailed in Section 5.2.1 below.

Eq. (7) is the simple Engle-Granger error-correction model where the coefficient of $\hat{\varepsilon}_{i,t-1}$ reveals whether entrances and exits of competing firms and adjustments of the fixed capital of the existing firms ensure that pure profits gravitate towards their long-run equilibrium in which the pure profit is zero following the model of Aghion et al. (2021). Blanchard (1997) also stress that changes in institutional constraints will affect abnormal markups. A reduction in featherbedding practices, for example, incentivizes the most affected firms to reduce their labor force leading to increasing unemployment and markups. The reduced wage growth caused by the increasing unemployment furthers the increase in markups and the capital share. The wage-induced higher markups will lead to entry of firms and capital accumulation until unemployment is back at its initial level.

Unionization is intended to capture the strength of unions by affecting the bargaining power of labor relative to that of capital (Bruno and Sachs, 1985; Blanchard, 1997; Roine et al., 2009; Alesina et al., 2018; Madsen et al., 2018; Farber et al., 2021). The unionization rate is likely to be influenced by significant foreign events that promote labor mobilization. When there is an emerging or eminent communist threat, for example, the elite, governments, and employers are more willing to accommodate workers' wage aspirations to prevent labor unrest or in the more extreme event, a communist revolt. Revolutions often result from general discontent that is kept dormant until a significant event, such as the Russian Revolution in 1917, triggers an outburst that can potentially spread internationally and result in regime change, unless the ruling class takes voluntary pre-emptive measures (Weyland, 2010). Unionization, however, may be a problematic explanatory variable since it may be endogenous. Acemoglu et al. (2001), for example, argue that skilled labor may choose not to join unions in periods with skill-biased technological progress to prevent their wages from being compressed by joining the union. Furthermore, the stalling unionization over the period 1980-1995 and its decline thereafter in the advanced countries have, to some extent, been influenced by the structural shift towards the service sector with low unionization propensities.

Changes in the *K-Y* ratio will influence the labor share if the elasticity of substitution between capital and labor, σ^{KL}, differs from one. Investment-specific technological progress that increases the real *K-Y* ratio, for example, increases (reduces) the labor share if $\sigma^{KL} < 1$ ($\sigma^{KL} > 1$) because the real price-induced decline in user cost of capital is overpowered by the increase in the *K-Y* ratio (Karabarbounis and Neiman, 2014). A similar effect arises from a reduction in the real interest rate that also reduces the user cost of capital. In addition to the direct effects on factor shares, Blanchard (1997) argues that an increasing *K-Y* ratio may indirectly affect the labor share by increasing unemployment, which through the Phillips curve, reduces the growth in real wages.

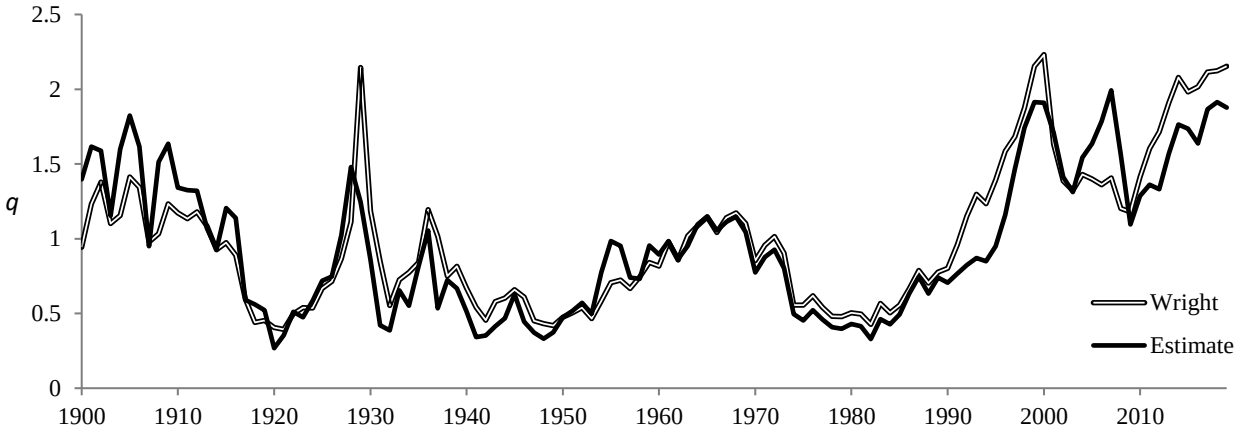
5.2 Data and graphical analysis

Details on the construction of Tobin's *q* and the functional income distribution are given below. Data sources are relegated to the Data Appendix.

5.2.1. Tobin's q. Except for the United States, estimates of Tobin's *q* are somewhat limited. Hence, we employ the method suggested by Barro (1990) in which Tobin's *q* is estimated as the residual from regressing the log of real share prices on a linear time-trend. This approach is consistent with the *q*-model derived in Section 3 for which *q* fluctuates around a constant level under perfect competition due to investment adjustment costs. Under imperfect competition, *q* may be driven away from its long-run equilibrium by markups. Alternatively, *q* above the perfect competition equilibrium may revert to equilibrium over time as pure profits are gradually eroded by competition (Aghion et al., 2021). This feature is implicitly incorporated into Barro's (1990) approach.

Figure 2 compares Tobin's *q* based on Barro's approach and the much more rigorous approach of Wright (2004) for the US over the period 1900-2018. The estimates are normalized to have a mean of one. The correlation coefficient between the two series is 0.89 (levels) and 0.92 (logs), suggesting that Barro's approach, at least benchmarked against Wright's estimate for the US, is performing well. The different timing of changes in *q* between the two estimates of *q* often rests on the timing of stock prices within the year. In Wright's estimates, for example, *q* peaks in 1928 because he bases *q* on the end-of-year market capitalization, while *q* peaks in 1929 in our estimates because we use year averages of stock prices. Another difference between the two series is that Wright's *q* is trending up slightly more than the estimated *q* after WWII, which is likely to reflect a downward jump in the retention ratio during WWII. As aforementioned, we include a split time-trend before and after WWII in the regression analysis to allow for a structural shift in the retention ratio (the share of earnings that is retained). In this context, it is important to note that the growth in real share prices over time is almost solely due to a positive retention ratio. If retained earnings are expended on tangible and intangible capital, then the numerator and denominator of *q* are equally affected for the unlevered corporation, while real stock prices increase – not because of increasing returns per unit of capital, as the casual observer may think, but because shareholders' claims on the fixed capital have increased.

Figure 2. Tobin's *q* for the US



Notes: Wright = Tobin's *q* estimated by Wright (2004); Estimate = Tobin's *q* estimated as the residual from regressing the log of real stock prices on a constant and a linear time-trend. Both series are adjusted to have a mean of one ~~and the standard deviation of Wright's (2004) data.~~

5.2.2. Labor's income share is estimated as the compensation to employees and divided by net national income in which fixed capital depreciation expenses of non-residential capital are deducted from GDP. We follow the convention of imputing earnings of the self-employed under the assumption that they earn the same amount per worker as the rest of the working population. To ensure that labor's income share is realigned with Tobin's *q*, which applies only to the productive sector, we remove residential rents from the net national income. To achieve this, we deduct the rental prices multiplied by the stock of residential capital from national income. Most of the income share data with imputed earnings of self-employed but in net terms, over approximately the past century are from the OECD's national accounts tables, the World Inequality Database, and Bengtsson and Waldenström's (2018) capital share database, https://sites.google.com/view/danielwaldenstrom/data-programs. We retropolate the data from 1900 data using various sources as detailed in the Data Appendix.

Figure 3. Union Membership Rate

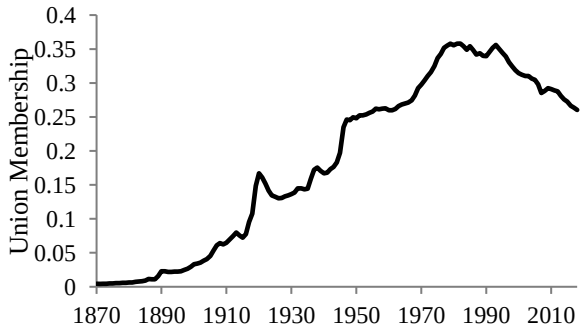
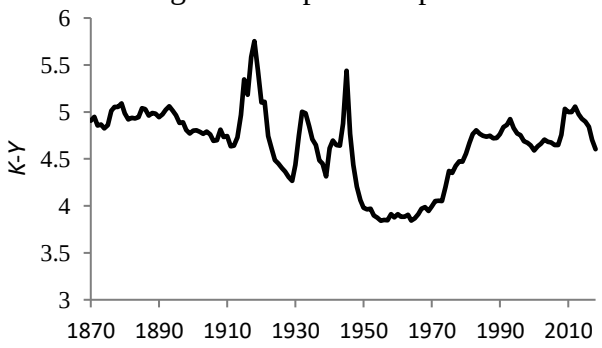


Figure 4. Capital-Output Ratio



Unionization and the nonresidential capital-output rate are displayed in Figures 3 and 4. Unionization fluctuates along an increasing trend up to the mid-1970s and declines, thereafter. The growth spurts in the approximate periods 1916-1921, 1945-1950 and 1967-1980 are often associated with heightened strike activity and worker unrest (Bruno and Sachs, 1985; Roine et al., 2009; Farber et al., 2021). The trend in the *K-Y* ratio is flat in the very long run, U-shaped in the medium term, and, due to capital

adjustment costs, counter-cyclical at business-cycle frequencies. The flat *K-Y* ratio in the very long-run suggest that the production technology is Cobb-Douglas in the steady state – the joint impact of an elasticity of substitution of one and Hicks-neutral technological progress. At medium frequencies the elasticity of substitution may be lower than one and the technological progress factor biased with varying signs and intensities as detailed below.

Table 1. Summary statistics, 1870-2018

Variable		Mean	Std. Dev.	Observations
$\ln S^L$	overall	-0.35	0.16	N = 3129
	between		0.11	n = 21
	within		0.12	T = 149
$\ln q$	overall	-0.10	0.48	N = 3129
	between		0.02	n = 21
	within		0.48	T = 149
$\ln Union$	overall	-2.54	1.76	N = 3129
	between		0.64	n = 21
	within		1.65	T = 149
$\ln K/Y$	overall	1.33	0.61	N = 3129
	between		0.57	n = 21
	within		0.26	T = 149

Notes: S^L = the labor share net of residential rent; *Union* = unionization rate; *K*/*Y* = ratio of non-residential capital to GDP net of depreciation of non-residential capital and residential housing rent; $N = n$ x T, where N is the number of observations, T is the number of years per country, and n is the number of countries.

5.3 Baseline Regressions

The results of estimating the cointegration model, Eq. (6), are presented in Table 2. The null hypothesis of cointegration is rejected in the two cointegration estimates (columns (1) and (2), suggesting that the coefficient estimates are super consistent and an error-correction representation of the data generating process exists. The coefficients of q in the cointegration and the error-correction models are all significantly negative at the 1% level. A one standard deviation increase in q is, on average, associated with a 1.16% reduction in the labor share, which translates into a 0.78 percentage point reduction in the labor share based on the sample average labor share of 0.7. To put this ostensibly small number into perspective, consider the post-1980 period during which Tobin's q increased by approximately 2.5 standard deviations, whilst the labor share decreased by 5.3%; thus, implying that Tobin's q accounts for approximately 52% of the decline in the labor income share over this period.

Table 2. Parameter estimates of the cointegration and error-correction models (Eqs. (6) and (7)), baseline regressions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Cointegration		**Error-correction**				
	$\ln S_t^L$	$\ln S_t^L$	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$
$\ln q_t$	-0.016*** (0.004)	-0.026*** (0.004)	-	-	-	-	-
$\Delta \ln q_t$	-	-	-0.025*** (0.005)	-0.026*** (0.004)	-0.024*** (0.005)	-0.023*** (0.004)	-0.015*** (0.004)
$\hat{\varepsilon}_{i,t-1}$	-	-	-0.253*** (0.058)	-0.166*** (0.030)	-0.274*** (0.093)	-0.176*** (0.042)	-0.162*** (0.06)
Period	1945-2018	1870-2018	1950-2018	1875-2018	1955-2018	1880-2018	1890-2018

Obs	1554	3129	1449	3024	1344	2919	2709
Spec.	Level	Level	5-year	5-year	10-year	10-year	20-year
ADF	-5.21***	-6.72***	-	-	-	-	-

Notes. ADF = Pedroni's Augmented Dicky-Fuller *t*-statistic for cointegration. Standard errors robust to heteroscedasticity and serial correlation are included in the parentheses, *** denotes 1% level of significance.

The coefficients of the error-correction terms in columns (3)-(7) are all significantly negative and between the range of zero and minus one, confirming that a long-run equilibrium exists and that *q*, and, therefore, markups, gravitate toward stable long-run equilibriums. The half-way cycle is reached after approximately three years, suggesting a relatively low capital adjustment costs of existing and new companies; a result that is consistent with the adjustment costs found in the literature (see, e.g., Bergeaud and Ray, 2021).

5.4 Inclusion of confounding variables

Unionization and the capital-output ratio are included sequentially and jointly in the estimates in this section. The results are reported in Table 3. Unionization is significantly positive in all cointegration estimates and in the error-correction models that are estimated over the period 1950-2018, but not the estimates over the period 1875-2018. The coefficients of unionization are significantly larger over the period 1950-2018 than over the period 1870-2018. We investigated whether the declining significance of unionization as we go back in time reflects the almost uninterrupted increasing unionization rate up until the 1980s, while income shares were fluctuating around a relatively constant level at the same time. However, using the residual from a regression of the log of unionization on a linear and a squared time trend in the structural regressions does not alter the results, suggesting that the trend in unionization in the regressions in Table 3 is captured by the time-dummies (the results are not shown). Furthermore, the effects of trade union wage pushiness on the labor share may be captured by Tobin's *q* because of the difficulties associated with the measurement of union wage pressure and the fact that unions and companies often share the pure profit (Blanchard, 1997; Checchi and Garcia-Penalosa, 2008). Furthermore, the impact of unionization on labor shares differ across different types of union bargaining models (Checchi and Garcia-Penalosa, 2008).

Table 3. Parameter estimates of the cointegration and error-correction models including confounding factors.

	(1)	(2)	(3)	(4)	(5)	(6)
	Cointegration estimates					
	$\ln S_t^L$	$\ln S_t^L$	$\ln S_t^L$	$\ln S_t^L$	$\ln S_t^L$	$\ln S_t^L$
$\ln q_t$	-0.015*** (0.004)	-0.024*** (0.004)	-0.013*** (0.004)	-0.020*** (0.004)	-0.013*** (0.004)	-0.019*** (0.004)
$\ln Union_t$	0.044*** (0.009)	0.009*** (0.003)	-	-	0.039*** (0.008)	0.006* (0.003)
$\ln (K/Y)_t$	-	-	0.06*** (0.020)	0.091*** (0.011)	0.044*** (0.019)	0.088*** (0.011)
Period	1945-2018	1870-2018	1945-2018	1870-2018	1945-2018	1870-2018
Obs.	1554	3129	1554	3129	1554	3129
Spec.	Level	Level	Level	Level	Level	Level
ADF	-4.55***	-5.75***	-3.51***	-5.86***	-3.05***	-4.96***
	Error-correction estimates					

	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$	$\Delta \ln S_t^L$
$\Delta \ln q_t$	**-0.023***** (0.005)	**-0.026***** (0.004)	**-0.019***** (0.005)	**-0.017***** (0.004)	**-0.017***** (0.005)	**-0.018***** (0.004)
$\Delta \ln Union_t$	**0.040***** (0.010)	-0.002 (0.0030)	-	-	**0.034***** (0.010)	-0.004 (0.003)
$\Delta \ln (K/Y)_t$	-	-	**0.111***** (0.029)	**0.098***** (0.012)	**0.102***** (0.028)	**0.099***** (0.022)
$\hat{\varepsilon}_{i,t-1}$	**-0.247***** (0.057)	**-0.171***** (0.031)	**-0.268***** (0.057)	**-0.165***** (0.030)	**-0.264***** (0.057)	**-0.169***** (0.0298)
Period	1950-2018	1875-2018	1950-2018	1875-2018	1950-2018	1875-2018
Obs.	1449	3024	1449	3024	1449	3024
Spec.	5-year	5-year	5-year	5-year	5-year	5-year

Notes. Standard errors robust to heteroscedasticity and serial correlation are contained in parentheses, *,**&*** denote 10%, 5% and 1% levels of significance.

The capital-output ratio, *K-Y*, is included in the regressions in the last four columns in Table 3. The coefficients of the *K-Y* ratio are all significantly positive, implying that the null hypothesis of $\sigma^{KL} = 1$ is rejected at the 1% level. The average coefficient of the *K-Y* ratio is 0.083, suggesting that $\sigma^{KL} = 0.80$ and, therefore, that the labor share is inversely related to the cost of capital.[2] Since the *K-Y* ratio has fluctuated around a decreasing trend since 1982, investment-specific technological progress could not have been responsible for the declining labor share over the same period. As shown by Kerspien and Madsen (2021), the impact of the declining real prices of machinery and equipment has been more than countered by stalling productivity in the building sector since 1970 (Kerspien and Madsen, 2021).

Returning to Tobin's *q*, the coefficients of *q* are significantly negative in all 12 regressions, suggesting that *q* is a robust determinant of factor shares. The estimated coefficients of *q* in the regressions in the last two columns in Table 3, where all control variables are included, are, on average for the cointegration and error-correction estimates, -0.017, which is close to that of the baseline regressions. These results suggest that the coefficient of *q* is quite resilient to the inclusion of control variables.

6 Counterfactual simulations

In Table 4 we quantify the effects of Tobin's *q*, unionization, and the *K-Y* ratio on the labor share. The first column shows the effects of a one standard deviation increase in each of the explanatory variables on the labor share based on the coefficients of the cointegration regression over the period 1870-2018. Within standard deviations are used because the focus is on explaining the time-variation in labor shares and not the between-country variation. Given that the labor share tends to fluctuate in a narrow band, the three principal variables explain a large share of the variations, where most of the remaining within-fluctuations in the labor share are explained by the time-dummies, which, to some extent, capture factor-biased technological progress. Tobin's *q* and unionization explain approximately equal amounts of the variation in the labor share, slightly less than the *K-Y* ratio.

[2] From a standard *K-L* CES production function we can derive the expression from the first-order condition: $\Delta \ln(S^K) = \frac{\sigma-1}{\sigma} \Delta \ln\left(\frac{K}{Y}\right)$, where the mapping between the labor and capital share is given by: $\Delta \ln(S^K) \approx -\Delta \ln(S^L) \cdot \frac{\overline{S^L}}{1-\overline{S^L}}$. Thus $\sigma \approx \left(\phi \frac{\overline{S^L}}{1-\overline{S^L}} + 1\right)^{-1}$, where ϕ is the coefficient of the *K-Y* ratio in the labor share regression. For this calculation we set $\overline{S^L} = 0.753$, which is the value of the average labor share in 1980.

Table 4. Counterfactual simulations. Factor impact on the labor share.

	Effects of one Std. Dev. increase, 1870-2018	Contribution to change in S^L, 1980-2018	%
Tobin's *q*	-0.013*0.68*0.753*100 = -0.67 percentage points	-0.013*1.661*0.753*100 = -1.63 percentage points	26
Union	0.039*0.37*0.753*100 = 1.09 percentage points	0.039*-0.313*0.753*100 = -0.92 percentage points	15
K-Y	0.044*0.16*0.753*100 = 0.53 percentage points	0.044*0.010*0.753*100 = 0.03 percentage points	0
Time-effects		-3.68 percentage points	59
Total, Explained		-6.23 percentage points	100
Total, Actual		-5.66 percentage points	

Notes: The first column shows the effects of a one standard deviation increase in Tobin's *q*, unionization, and the *K-Y* ratio on the labor share in percentage points, estimated as the coefficients from the cointegration estimates, 1870-2018 (Table 3, column (6)), times the standard deviation times the average labor share in 1980, 1870-2018. The second column shows the effects of the change in Tobin's *q*, unionization, and the *K-Y* ratio on the labor share in percentage points and is estimated as the coefficients from the cointegration estimates, 1950-2018 (Table 3, column (6)), times their percentage changes over the period 1980-2018 times the average labor share in 1980, 1950-2018. The last column shows the distribution of the total explained decline in the labor share since 1980, where the average labor share of 0.753 is its value in 1980. Within standard deviations are used.

Considering the post-1980 period, the increasing markups explain 29% of the actual reduction of the labor share, while declining unionization has contributed 16% to the decline, and the *K-Y* ratio has hardly had any impact on factor shares. As the biggest contributor, the time-dummies account for 59% of the explained decline in the labor share and they may have captured the effects of measure errors of the non-deterministic variables, factor-biased technological progress, and other influences. Thus, in line with the findings for the US, increasing markups have not only been influential for the declining labor share in the US since the early 1980s, but also for the advanced countries in general.

7 Conclusion

Devising Tobin's *q* as a measure of markups, we show that markups have been influential for income shares over the period 1870-2018 for the advanced countries; a finding that supports the theoretical and empirical work for the US of Caballero et al. (2017), Eggertsson et al. (2018), Farhi and Gourio (2018), Autor et al. (2020), Barkai (2020), De Loecker et al. (2020), and Aghion et al. (2021). More generally, we find that markups have been influential for factor shares throughout the developed world over at least the past one and a half centuries, not just for the United States over the past few decades. Furthermore, we find markups tend to gravitate toward constant non-negative levels in the long run, suggesting that the recent upward trend in markups will eventually subside. This can either happen because of 1) an inflow of competing firms reduces and even eliminates the excess profits, as predicted by the theory of Aghion et al. (2021); 2) capital deepening by existing firms; or 3) endogenous policy responses that strengthen antitrust laws or make it more difficult for multinational corporations to transfer income to tax heavens. Finally, we find that Tobin's *q*, unionization and capital deepening are all approximately equally influential for factor shares over the period 1870-2018, while, of the three principal determinants of the labor share considered here, increasing markups have been the most influential driver of the decline in the labor share since 1980.

Following the literature, we have not tested whether the relationship between the labor share and markups is causal. Instead we have controlled the principal determinants of factor shares, such as unionization, capital deepening and factor-biased technological progress; thus, eliminating probably the largest source of endogeneity – omitted variables. Furthermore, the medium-term movements in the average Tobin's *q* for the advanced countries are consistent with the historical narratives on factors

that are likely to have influenced the path of markups since 1870, such as the positive effects of the globalization and deregulation waves before WWI and after 1980, the negative effects of the recessions and depressions over the periods 1920-1921, 1930-1933, 1974-1982, and the mixed effects of the interwar nationalism and the post-WWII golden period with high growth but also a strong antibusiness sentiment.

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