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Rising markups and the fall of the labor share:

Predicting the effects of industry market power in the U.S.

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Abstract

This paper examines the downward trend in the U.S. labor share of income, which is shown to have declined significantly over the last two decades. This phenomenon is in direct contradiction with standard neoclassical growth theory, which postulates constant factor shares of income. Increased trade with low-income countries, financialization, and the decline of labor unions are some of the explanations that have been put forward, sometimes with ambiguous evidence. We develop a model to examine the effect of a rise in the markup of firms on the labor share. Increasing markups imply that monopoly rents rise at the expense of labor and also capital income. This result holds if the economy is characterized by a Cobb-Douglas production function or a CES (constant elasticity of substitution) production function. We use both a standard regression as well as a Bayesian approach to estimate U.S. industry markups over time. Our results suggest that markups in the private sector might have risen by as much as 7 to 12 percent from the early 1980s until today. Moreover, this significant aggregate increase in monopoly power can explain almost the entire fall of the U.S. labor share over the same time period.

Keywords:

labor share, markup, monopoly, market power, production function, returns to scale

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1. Introduction

The British economist Nicholas Kaldor observed in the late 1950s that the labor share of income for the United States (U.S.) had been relatively constant over time. Indeed, total labor compensation as a share of GDP has fluctuated around a value relatively close to 2/3 in the U.S for many decades. This so-called stylized fact has also held true for other countries (Sørensen & Whitta-Jacobsen, 2010, pp. 47-50). Based on that, neoclassical growth theory usually employs the Cobb-Douglas production function, which has the property that factor shares of income are constant.

However, the labor share of GDP has shown a remarkable downward trend in the U.S. over the last decade. Since 2000, our calculations of the adjusted labor share based on the National Income and Product Accounts (NIPA) show a steady decline down to a record-low of 57 percent. A similar downward trend and an even steeper decline in recent years can be observed for the adjusted labor share for private industries, which will be the primary focus of this paper (see figure 1). Furthermore, this tendency is not only typical of the U.S. economy, but seems to be quite global in nature instead. Karabarbounis and Neiman (2013), for example, find that in a sample of 59 countries, 37 display a statistically significant negative trend in the labor income share of GDP over the period from 1975 to 2012.

The significant fall of total labor compensation as a share of GDP is an interesting and research-worthy topic in itself. It is of importance to investigate the underlying causes, as the consequences that follow the decline in the labor share may also be quite severe. Usually, the richest people in society derive a large fraction of their income from capital they have accumulated or inherited. The middle class and the economically disadvantaged, on the other hand, are mostly reliant on labor compensation. Inequality within the economy would thus increase significantly if real wages were to stagnate or even fall. This is exactly what happened in the U.S. economy over the last three decades where real wages have evolved very poorly for a large part of the population. Krugman (2014), for example, shows that real median family income has significantly underperformed when compared to productivity growth. The former rose by about 150 percent in between 1947 and 2011 while the latter increased by roughly 300 percent over the same time period. However, this great divergence between real median family income and productivity only started to emerge in the early 1980s and the relative gap has increased in size ever since.

The fall of the labor share and the associated decline in real wages illustrate the so-called ‘squeezing’ of the American middle class in recent years, which is considered to be the backbone of the U.S. economy. A general downward trend in the labor share is thus likely to be accompanied by rising inequality in society. This will also have political consequences as political bargaining power shifts towards those who are now relatively wealthier. In theory, a negative feedback loop could emerge in which the wealthy become politically more influential and then shape policies in such a way that would facilitate their wealth accumulation even further. This could eventually lead to societal conflicts and the uprising of labor à la Karl Marx (1867, pp. 535-36) as inequality surges and capital accumulation by the wealthy few becomes intolerable to the general population.

Trying to explain the fall of the labor share, several different hypotheses have been put forward. Increased international trade, increased financialization, and the decreasing bargaining power of labor unions are just a few of the culprits that have been identified, rightly or wrongly. Our thesis focuses on another explanation, one which has so far not received the attention it deserves, namely increasing monopolization. As more and more sectors in the economy face a higher degree of monopolization, total economic rents as a share of GDP rise at the expense of production factors such as labor, and ironically, also capital. Monopolization can be viewed as the extent to which corporations are able to use their market power to achieve a higher markup over factor cost. Consequently, a high markup is associated with a high degree of monopolization.

This paper has three main objectives. First, we develop a model that explains how the markup affects the labor share of income. Secondly, we estimate the change in the markup for the U.S. private sector, at industry as well as the aggregate level using both a traditional and a Bayesian approach. Lastly, we test our model by predicting the fall of the labor share using the observed markup-changes and a range of different parameter values.

Our analysis suggests that markups across different U.S. industries, as well as for the private sector as a whole, have indeed risen substantially over the last two decades. More specifically, our findings indicate that markups in the private sector have risen by about 7 to 12 percent from the early 1980s until today. Moreover, our model suggests that this increase can explain almost the entire fall of the labor share.

Our paper is structured as follows. The first section presents some empirical facts on the fall of the labor share in the U.S. This is followed by a literature overview on the most important explanations that have been put forward to explain this phenomenon. We then present a theoretical model that can explain how markups and other factors affect the labor share. The subsequent section puts forward the methodology we use to estimate markups across industries. This is followed by an exposition of our results, including robustness checks and a sensitivity analysis. Last but not least we discuss the foundations and implications of our results and offer some concluding remarks.

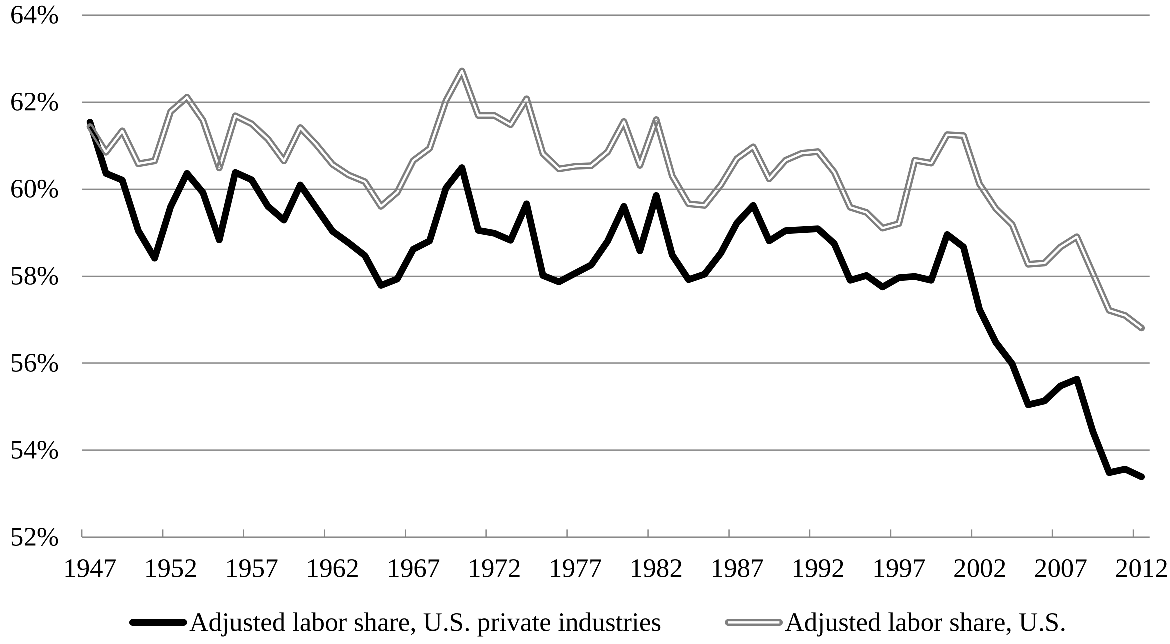
2. The fall of the labor share of income

The labor share is simply the ratio between labor compensation and value added. Figure 1 illustrates the adjusted labor share for U.S. private industries[1] as well as for the entire economy from 1947 until 2012. Value added and the compensation of employees is reported in the National Product and Income Accounts (NIPA) on the industry level, but as for the labor income of self-employed, data is elusive. While the total income of the self-employed is readily reported in the NIPA, we do not know what share of their income accrues to labor and what share is the return to a risky entrepreneurial and/or financial investment. Neglecting the self-employed could lead to biased estimates of the decline in the labor share if the share of self-employed or the nature of their work changes over time.

We calculate a proxy for the labor income of the self-employed by assuming they have the same average annual wage compensation as regular employees working in the same industry. The number of self-employed in a particular industry, reported in the NIPA, can then simply be multiplied by the average annual industry wage to obtain the total wage compensation of the self-employed per industry in a given year. Adding the total wage compensation of employees and self-employed and aggregating will give us a reasonably accurate estimate of total private sector wage compensation. Finally, we simply divide by value added for private industries to obtain the adjusted labor share.

[1] The Bureau of Economic Analysis defines the U.S. private sector as the aggregate of the main industry classification groups according to NAICS (North American Industry Classification System), less government. Before 1998, the SIC (Standard Industrial Classification) system was used.

Figure 1: The adjusted labor share



Our adjustment for the self-employed will be biased if the self-employed earn, on average, a significantly higher (or lower) wage than their employee counterparts, which may well be true for some industries. For example, one could argue that the self-employed in the construction industry likely earn less than the average employee. However, any potential bias resulting from our assumption of equal wage compensation is likely to be small since the number of self-employed in most industries is relatively low[2].

In figure 1, we can see that the adjusted labor share for private industries fluctuated around a constant level of around 59 percent from 1950 until the early 2000s. The fluctuations are likely the result of the business cycle. Around 2000, however, one can see a clear downward trend that has not been reversed as of the time of writing. The labor share hit a record-low of 53 percent in 2012. This represents a fall of about 9 percent (or about 6 percentage points) from its 1981 to 1998 average value of 59 percent (why this particular reference period is chosen will be explained in our analysis later on).

In order to further understand the fall of the labor share, we can identify the proximate cause by a simple decomposition. Karabarbounis & Neiman (2013) suggest using the following formula:

(1) $$\Delta s_L = \sum_k \bar{y}_k \Delta s_{L,k} + \sum_k \bar{s}_{L,k} \Delta y_k$$

where $y_{t,k}$ denotes the value added by industry k at time t, $\bar{x}$ denotes the mean of a variable, and Δx denotes the change in a variable according to a linearly fitted trend. This decomposition recognizes that a change in the labor share can be the result of a within-industry effect, the first term on the right-hand side of equation (1), as well as a structural effect (the second term). The structural effect is a result of industries' relative contributions to total value added shifting over time, forming an aggregate shift.

[2] In 2012, less than 8.5% of all workers in private industries were self-employed. However, the variation in between different industries is very large, ranging from 0 percent in utilities and 2.5 percent in mining to more than 20 percent in construction and 40 percent in agriculture, for example.

This paper focuses on the within-industry effect, which captures changes in the labor share due to innate changes in the organization and production processes of each industry, or structural changes on a societal level. Table 1 in the appendix presents a decomposition of the change in the labor share from 2000 until 2012, the period in which we observe the substantial decline. We have data for all 15 major industry groups as well as for the government sector.

When comparing the within and structural components of the decomposition, we find that the within component explains almost the entire fall of the labor share of income from 2000 onwards whereas the structural component is very small. We can conclude that the fall of the labor share cannot be attributed to sectorial shifts in the economy, i.e. the recent change cannot be explained by a decrease in labor-intensive sectors' relative contribution to GDP. Indeed, we note that the labor share fell in 12 out of 15 industries.

3. Literature review

This section provides an overview of a few of the different explanations for the falling labor share pursued by researchers. We will briefly explore the following distinct explanations: Capital-biased technological change, increased international trade, decreased labor union bargaining power, increased financialization, and finally our hypothesis of increasing markups. One should note that these theories should be seen as complements rather than substitutes, as the phenomenon of a falling labor share is likely the result of many different factors. Furthermore, we will see below how some of the theories are highly interrelated. The bargaining power of unions, markups and to some degree financialization are all highly related to the market power of the firm, in factor as well as product markets.

3.1. Capital-biased technological change

Hicks (1932) was among the first to emphasize that non-neutral technological change can alter the factor shares of incomes. The idea is simply that firms tend to economize on the more costly factor of production. By definition, capital-biased technological change reduces the cost of one unit of effective capital (relative to one unit of effective labor). Consequently, firms face an incentive to switch production technology and employ more capital. As a result, the labor share of income decreases.

One should note, however, that capital-augmenting technological change and decreases in the relative price of capital do not necessarily have to reduce the labor share of income. In fact, the above-mentioned effects are highly dependent on the elasticity of substitution between capital and labor (which we will denote by σ), i.e. to what degree labor will be substituted for capital (and vice versa) by a cost-minimizing firm given a change in the relative factor prices. The standard Cobb-Douglas production function can be shown to have an elasticity of one, meaning that a one percent increase in the amount of capital will lead to exactly a one percent decrease in the relative marginal productivity of capital. We will later see that in the case of the Cobb-Douglas production function, non-neutral technological change and changes in factor prices actually do not have any long-run impact on the factor shares of income (Jones, 2003). Finally, if the factors of production are not easily substitutable, then capital-biased technological change can actually increase the labor share of income. The size of the elasticity of substitution parameter is ultimately a matter of empirics, but as Elsby et al. (2013) notes, an elasticity alone does not explain the fall of the labor share.

Jones (2003) argues that the long-term production function is likely to be Cobb-Douglas. In that case, technological change does not affect the long-run factor shares of income. Karabarbounis and Neiman (2013), on the other hand, estimate the elasticity of substitution between labor and capital to roughly

1.25. This estimate is the foundation of their main result that an observed decline in the relative price of investment can explain half of the decline in the labor share of income. However, this finding is debated by Elsby et al. (2013) who argue that the key mechanism is the capital-labor ratio, which must necessarily increase under an elasticity greater than 1. They find that the change in the ratio implied by an elasticity of 1.25 does not have empirical support. Klump et al. (2007) estimate the elasticity to an interval between 0.5 and 0.7. Jones (2003) notes that the short-run elasticity of substitution is likely to differ from the long-run, implying that quantitatively different estimates need not be conflicting. Viewing the elasticity parameter as the variety of production methods available to a given firm, it seems reasonable that the elasticity parameter can be dependent on locality and a range of different factors in addition to time.

The constant factor income shares have long been thought of as a desirable property of the Cobb-Douglas production function, as it seems to correspond relatively well to empirical evidence. Additionally, in the standard neo-classical growth model, constant factor income shares are a well-known property of steady-state growth, making the Cobb-Douglas production function desirable, but not necessary. Uzawa (1961) proved that a growth model with constant, nonzero, factor income shares and a constant growth rate must be characterized by a production function of the form $Y = F(K, AL)$, where the growth rate of technology is equal to the steady state growth rate of output. Acemoglu (2003) also notes that most estimates of the elasticity of substitution between labor and capital are less than one and provides microfoundations explaining why technology must be purely labor-augmenting along a balanced growth path given an elasticity below one. We will use this result in our analysis.

3.2. Globalization and increasing trade

An alternative explanation is that increasing globalization and the related increase in international trade has negatively affected the labor share of income. The classical international trade theory developed by Heckscher and Ohlin states that a country's comparative advantage is based on its factor endowments (Ohlin, 1933). Every country specializes in the production of the good that uses its abundant factor of production. In a world with only two factors of production, labor and capital, developed countries thus specialize in the production of the capital-intensive product whereas developing countries specialize in the production of the labor-intensive product. Since trade will lead to factor price equalization in the long run, the abundant factor of production experiences a relative gain from trade (Samuelson and Stolper, 1941). Accordingly, the Stolper-Samuelson theorem predicts that international trade should benefit capital in industrialized countries and labor in developing countries, which seems to be in accordance with the observation of a declining labor share of income in developed nations. Krugman (2008) notes that the U.S. economy has become increasingly more open over the last few decades, as measured by the sum of exports and imports divided by GDP. More importantly, relative trade with developing countries has grown much faster in recent years. 2006 was the first year in which the United States traded more manufactured goods with developing countries than with other developed countries. For example, trade with Mexico and China rose by a factor of two and eight, respectively, in between 1990 and 2006, far outpacing trade growth with advanced economies (Krugman, 2008).

In addition to the Heckscher-Ohlin explanation of factor endowments, Rodrik (1998) suggests that greater trade openness increases the elasticity of demand for labor and thus negatively affects the bargaining power of workers. Indeed, Jaumotte and Tytell (2007) find some evidence that increased globalization can account for some part of the fall of total labor compensation as a share of GDP, even though they accord a larger role to capital-biased technological change.

However, there are some important caveats with the trade explanation. Firstly, one should note is that in practice there are many more factors of production other than capital and raw labor (one can distinguish between skilled vs. unskilled labor, for example). In the case of multiple types of labor, it is not straightforward whether total wage compensation should actually decline in developed countries if international trade gains in importance. Secondly, a large part of international trade can be better explained by other phenomena, such as intra-industry trade resulting from love of variety and economies of scale rather than factor endowments (see, for example, Krugman (1981)). Accordingly, we see that a lot of trade actually takes place between many developed countries that seem to share the same relative factor endowments.

Finally and perhaps most importantly, Krugman and others have argued that the supposed impact of trade liberalization has little empirical support, at least in the case of the U.S. That is because total trade with non-OECD countries accounts for no more than 2% of U.S. GDP (Aghion and Howitt, 2009, pp. 174-175). In general, there are some arguments to be made that increased globalization could negatively affect the labor share even though this is far from certain. The total effect, however, is likely to be small and cannot possibly account for the large fall of the U.S. labor share since the 1980s. This proposition, however, is to some extent disputed by Elsby et al. (2013) who suggest that a significant fall of the labor share can be attributed to offshoring of the labor-intensive component of the U.S. supply chain.

3.3. Financialization and weakened labor market institutions

That technology and trade can both serve to decrease the relative importance of domestic labor in production fits relatively well into a standard neo-classical analysis of the firm. Our remaining explanations take a different approach to the fall of the labor share, emphasizing the context of the firm as well as the rent-seeking behavior innate to owners of different production factors. Under imperfect competition, profit-maximization will entail the practice of mark-up pricing, or charging a price greater than marginal cost (Lerner, 1934). Markup pricing creates revenues in excess of those needed to pay each factor of production their marginal product, resulting in economic profits or rents. This study aims at estimating the change in the markup and relating them to the change in the labor share. In this section, we identify some of the different mechanisms determining the size and distribution of the rents derived from markup pricing. Table 2 illustrates some of the mechanisms commonly recognized as indicative of increasing markups. Note that these characterizations are not mutually exclusive.

Labor market institutions, such as labor unions and welfare systems, affect the bargaining power of workers. Fichtenbaum (2011) explains that labor unions should not be able to affect the labor share in a setting of perfect competition since factors are paid their marginal products. Under imperfect competition, however, weakened labor market institutions serve to deteriorate the bargaining power of workers when it comes to the distribution of economic rents. This argument is somewhat related to Kalecki's (1965) theory of monopoly power and pricing. One of Kalicki's claims is that the markup is negatively related to the strength of labor unions, as strong labor unions will deter rent-seeking by firm owners altogether, since any price increase will be met by demand for higher wages, eliminating additional profit. Weaker unions would, on the other hand, encourage markups as well as depress real wage growth, both of which would serve to decrease the labor share of income. Shiller (2005, p. 34) notes that the fraction of U.S. wage and salary workers who were union members fell to 12.9 percent in 2003, down from 20.1 percent in 1983. The decline in the private sector was even more striking, where the fraction fell from 16.5 percent to 8.2 percent over the same time period. According to Fichtenbaum (2011), this decline in labor union membership explains about 30 percent of the fall of total labor compensation as a share of GDP in the U.S. between 1997 and 2006. Elsby et al. (2013), on the other hand, find very limited support that de-unionization negatively affected the labor share.

Related to the distribution of profits is a novel concept developed by heterodox economists over the past decade known as financialization. Definitions of financialization range from very broad, such as Epstein (2005): "...the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies", to relatively narrow, such as Stockhammer (2013): "...rising indebtedness of households, more volatile exchange rates and asset prices, short-termism of financial institutions, and shareholder value orientation of non-financial businesses.".

Among financialization scholars, a common narrative is that the return of various financial assets have increased over the last decades. Not because of the relative scarcity of financial capital or an increase in its relative marginal productivity, but rather due to successful rent-seeking and regulatory capture (Epstein & Yayadev, 2007).

There are several hypothetical links between financialization and the labor share. Stockhammer (2013), for example, argues that global deregulation and liberalization of financial markets reduces the bargaining power of workers. He explains that with greater access to financial markets, firms face a larger number of investment opportunities, both domestic and abroad. As firms enjoy more flexibility with respect to investment and hiring opportunities, the relative bargaining power of labor decreases, leading to a rise in markups (potentially through a decline in real wages) and thus a fall of total wage compensation.

An increasing reliance on debt for consumption purposes, with corporations acting as financial intermediaries is also part of the financialization story. Hein and Mundt (2012) note that household debt as a percentage of annual disposable income rose significantly in the U.S. (and other industrialized countries) in between 1995 and 2005.

According to Stockhammer (2013), financialization also includes some other phenomena, such as the rise in corporate indebtedness and an increased focus on short-termism: The tendency of financial markets and financial actors to focus on short-term gains, potentially at the expense of long-term sustainability. Rossman (2009), for example, notes the increase in leveraged buyouts, in which private equity funds buy firms by taking on debt that is then transferred back to the firms. The financial surplus is channeled to the buyer through dividend payments or interest. The restructured firms are left with the burden of managing their excessive debt and have to resort to aggressive cost-cutting strategies in order to survive, often at the expense of the workers (Stockhammer, 2013). It is thus argued that the increased focus on short-term financial gain has come at the expense of the bargaining power of labor. Again, the markup is affected through changes in the cost structure of firms by way of lower real wages or layoffs. Lin and Tomaskovic-Devey (2013) argue that an increase in the ratio of financial income to realized earnings in U.S. non-financial corporations have served to decouple wages from production, causing an increase in inequality and a decrease in the labor share of income. They conclude that roughly half of the observed decrease in the labor share can be attributed to financialization in the form of an increased importance of financial income in non-financial firms.

Another argument why a larger financial sector might reduce the labor share is by simply being uncompetitive. The financial industry in many countries is indeed highly concentrated and financial firms seem to enjoy significant market power. In the U.S., for example, the top six bank holding companies hold roughly 67 percent of total assets in the financial sector in 2013, which represents an increase of 37 percent in five years (Gandel, 2013). Structural changes in the economy that lead to a greater importance of the financial sector as a share of GDP are thus likely to increase total corporate profits at the expense of labor compensation.

3.4. Monopolization and markups

Our hypothesis is that a general increase in the market power of firms may have a negative effect on the labor share. In this area, there has been surprisingly little academic work done, but probably not for lack of interest. Measuring the market power of firms on industry or aggregate level is a daunting task. Foster et al. (2011) show that concentration ratios, the percentage of revenues accounted for by the largest firms in a market, have risen sharply in many industries. It is also interesting to note that the largest American corporations presently enjoy record sales levels. Figure 2 in the appendix documents the rise in the ratio of total revenues of the Fortune 100[3] companies to GDP. While this can be explained by increased sales overseas, it does not contradict the idea that the market power of large firms has increased, resulting in higher markups and a fall of the labor share. The figure also shows a recent surge in U.S. corporate profits as a share of GDP, which coincides with the fall of the labor share that took place over the last decade. To estimate the level of the markup for different periods, we use in what follows a method that is loosely based on Robert Hall's original approach developed in the late 1980s (Hall, 1988). This, in turn, allows us to get an estimate of the change in the markup by comparing the values from one period to the next.

Even though Lynn and Longman (2010) and Foster et al. (2011) specify some of the negative aspects of increasing monopolization, such as a reduction in the bargaining power of workers, they do not directly link it to the fall of the labor share of income. Recently, Krugman (2013a) amongst others pointed out this potential relationship. He also sketched a few equations that can explain this dynamic (2013b) and we will use part of his ingredients in our own model. Cohen-Setten (2013) provides a nice summary of the discussion on rising monopoly rents and falling labor compensation that took place in the economics blogosphere last year, as a result of Krugman's writing. However, to our knowledge no recent empirical academic paper has assessed to what extent rising monopolization throughout the economy can explain the decrease in the share of GDP accruing to labor compensation.

Table 2 shows that financialization and the weakenening of labor market institutions are part of the monopolization story insofar as they can lead to a higher markup by affecting a company's cost structure, i.e. reducing the compensation of employees, for example. The two other mechanisms that tend to affect the markup are more related to a 'pure competition' effect. Both mergers and increased product differentiation can increase monopoly power by reducing the elasticity of demand for a firm's product. However, it is important to note that monopolization and market power are broad concepts in the sense that they are associated with a range of symptoms, increasing markups being one of them.

Table 2: Factors influencing the markup

	Transmission	
Markup determinant	Elasticity of demand	Cost structure
Increased product differentiation	*Increased markup*	
Mergers and acquisitions	*Increased markup*	
Weakened labor market institutions		*Increased markup*
Financialization		*Increased markup*

[3] The Fortune 100 companies are the largest 100 U.S. companies ranked by gross revenue.

4. Model

In this section, we present a theoretical model that relates the increased market power of firms to a smaller labor share of income. Our model uses some of the ingredients laid out by Krugman (2013b), but also relies on Karabarbounis and Neiman (2013). We assume that there is a large number of final goods producers in the economy engaging in monopolistic competition. Each firm produces one differentiated product, so that each industry is made up of exactly one firm. Because products are perceived as imperfect substitutes, firms exert some market power and charge a markup over marginal cost. We will later see that the markup depends on the elasticity of substitution between products. We assume that consumers have a constant elasticity of substitution (CES) utility function à la Dixit-Stiglitz (1977):

(1) $$U = \left(\int_0^n q(\omega)^\rho \, d\omega\right)^{\frac{1}{\rho}} \qquad \text{with } 0 < \rho < 1$$

$q(\omega)$ is the consumption of variety ω, n is the mass of varieties available to consumers, and ρ is a measure of substitutability between products. A standard result is that the demand for product ω can be written as follows if the price level and consumer income are both normalized to one:

(2) $$q(\omega) = p(\omega)^{-\sigma} \qquad \text{with } \sigma = \frac{1}{1-\rho} > 1$$

The quantity demanded of product ω depends on the price p and the elasticity of substitution between products denoted as σ. The demand function (2) can be rewritten as the usual Dixit-Stiglitz inverse demand function:

(3) $$p(\omega) = q(\omega)^{-\frac{1}{\sigma}}$$

We now assume that every firm produces their differentiated final good according to the same constant returns to scale CES production function, which is also employed by Karabarbounis and Neiman (2013):

(4) $$q = [(1-\alpha)A_k K^{\frac{\varepsilon-1}{\varepsilon}} + \alpha(A_L L)^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}}$$

L and K are the inputs of capital and labor that the firm uses to produce its output. A_k and A_L are capital-augmenting and labor-augmenting technology respectively, α is the so-called distribution parameter, and $\varepsilon > 0$ denotes the elasticity of substitution between capital and labor. The limit of the CES production function as ε approaches one is simply the Cobb-Douglas production function:

(5) $$q = A_k K^{(1-\alpha)}(A_L L)^{\alpha}$$

From equation (4), we can calculate the marginal product of capital and the marginal product of labor respectively:

(6) $$MP_K = (1-\alpha)A_K^{\frac{\varepsilon-1}{\varepsilon}}\left(\frac{q}{K}\right)^{\frac{1}{\varepsilon}}$$

(7) $$MP_L = \alpha A_L^{\frac{\varepsilon-1}{\varepsilon}}\left(\frac{q}{L}\right)^{\frac{1}{\varepsilon}}$$

The profit function of a single final goods producer can be expressed as follows:

(8) $$\pi = p(q) * q - c(w, r, q)$$

where $c(w, r, q)$ is a general cost function. The first order condition for the monopolist's profit maximization problem is:

(9) $$\frac{\partial\pi}{\partial q} = p'(q) * q + p(q) - \frac{\partial c(w,r,q)}{\partial q} = 0$$

From standard microeconomics, we know that a monopolist sets the marginal revenue products equal to the factor prices. We calculate the marginal revenue products using the inverse demand function (3) and the production function (4) and set them equal to the factor prices r and w respectively:

(10) $$MRP_K = MR * MP_K = [p'(q) * q + p(q)] * (1-\alpha)A_K^{\frac{\varepsilon-1}{\varepsilon}}(\frac{q}{K})^{\frac{1}{\varepsilon}} =$$

$$= \left[-\frac{1}{\sigma}q^{-\frac{1}{\sigma}-1} * q + q^{-\frac{1}{\sigma}}\right] * (1-\alpha)A_K^{\frac{\varepsilon-1}{\varepsilon}}(\frac{q}{K})^{\frac{1}{\varepsilon}} = q^{-\frac{1}{\sigma}}(1-\frac{1}{\sigma})(1-\alpha)A_K^{\frac{\varepsilon-1}{\varepsilon}}(\frac{q}{K})^{\frac{1}{\varepsilon}} = r$$

(11) $$MRP_L = MR * MP_L = [p'(q) * q + p(q)] * \alpha A_L^{\frac{\varepsilon-1}{\varepsilon}}(\frac{q}{K})^{\frac{1}{\varepsilon}} =$$

$$= \left[-\frac{1}{\sigma}q^{-\frac{1}{\sigma}-1} * q + q^{-\frac{1}{\sigma}}\right] * \alpha A_L^{\frac{\varepsilon-1}{\varepsilon}}(\frac{q}{K})^{\frac{1}{\varepsilon}}$$

$$= q^{-\frac{1}{\sigma}}(\frac{\sigma-1}{\sigma})\alpha A_L^{\frac{\varepsilon-1}{\varepsilon}}(\frac{q}{K})^{\frac{1}{\varepsilon}} = w$$

From equation (3) we know that $p(\omega) = q(\omega)^{-\frac{1}{\sigma}}$, which we normalize to one. The monopolist's markup over factor prices is $\mu = \sigma/(\sigma-1)$, the standard result when using the Dixit-Stiglitz demand function. Our model exemplifies a very general outcome, which is that firms set the marginal revenue product as a markup over factor input prices under decreasing marginal revenue. The markup is generally an increasing function of the market power wielded by firms. Substituting μ into (10) and (11) as well as normalizing the price of the product to one, we obtain the following first-order conditions (Karabarbounis and Neiman, 2013):

(12) $$MRP_K = \frac{1}{\mu} * (1-\alpha)A_K^{\frac{\varepsilon-1}{\varepsilon}}(\frac{q}{K})^{\frac{1}{\varepsilon}} = r$$

(13) $$MRP_L = \frac{1}{\mu} * \alpha A_L^{\frac{\varepsilon-1}{\varepsilon}}(\frac{q}{K})^{\frac{1}{\varepsilon}} = w$$

Since we only have two factors of production in our model, capital and labor, total income will be the sum of the capital share of income, the labor share of income, and monopoly rents. Since we assume all industries to be identical in terms of production and size, it is trivial to aggregate across the entire economy. Equations (14) to (16) are the expressions for the income shares of GDP (Y):

(14) $$s_K = \frac{rK}{Y} = \frac{1}{\mu} * \frac{rK}{wL+rK}$$

(15) $$s_L = \frac{wL}{Y} = \frac{1}{\mu} * \frac{wL}{wL+rK}$$

(16) $$s_\pi = \frac{\pi}{Y} = 1 - \frac{1}{\mu}$$

Evidently, the factor shares must sum up to one.

(17) $$s_K + s_L + s_\pi = 1 \qquad \Leftrightarrow \qquad rK + wL + \pi = Y$$

Using the first-order condition for capital (12) and the definitions of the income shares, it is possible to derive the following expression for the labor share of income.

(18) $$1 - \mu_t s_{L,t} = (1-\alpha)^\varepsilon \left(\frac{A_{K,t}}{\mu_t R_t}\right)^{\varepsilon-1}$$

Expressing (18) as the relative change between two time periods, t and t' > t, we get the following:

(19) $$\left(\frac{1}{1-\mu_t s_{L,t}}\right)(1 - s_{L,t}(1+\hat{s}_L)\mu_t(1+\hat{\mu})) = \left(\frac{1+\hat{A}_K}{(1+\hat{\mu})(1+\hat{R})}\right)^{\varepsilon-1}$$

where $\hat{X} = X_{t'}/X_t - 1$, i.e. the percentage change in a variable. Note that the distribution parameter from (18) is eliminated since we assume it to be time-invariant. Solving (19) for the change in labor share, we get the following expression:

(20) $$1+\hat{s}_L = \frac{1-\left[(1-\mu_t s_{L,t})\left(\frac{1+\hat{A}_K}{(1+\hat{\mu})(1+\hat{R})}\right)^{\varepsilon-1}\right]}{s_{L,t}\mu_t(1+\hat{\mu})}$$

While cumbersome, note that under unit elasticity (20) reduces to:

(21) $$1+\hat{s}_L = \frac{1}{1+\hat{\mu}}$$

Equation (20) is at the core of this paper as it allows us to examine the effects of a markup change on the labor share while controlling for two other potentially influencing factors, capital-augmenting technological change and the price of capital. Solving (18) for the labor share, it is possible to draw a few general conclusions regarding the impact of these variables on the change in the labor share.

(22) $$s_{L,t} = \frac{1}{\mu_t} - \left(\frac{(1-\alpha)}{\mu_t}\right)^{\varepsilon}\left(\frac{A_{K,t}}{R_t}\right)^{\varepsilon-1}$$

From this, it is easy to see that the effect of capital-augmenting technology and the price of capital depend on the elasticity of substitution. For $\varepsilon > 1$, technological progress will decrease the labor share as firms substitute away from labor and an increase in the price of capital will have the opposite effect, a substitution away from capital. For low levels of substitutability, i.e. $\varepsilon < 1$, the effects are reversed as the expenditure effect dominates the substitution effect. For $\varepsilon = 1$, the effects cancel out and relative prices and technology have no effect on factor income shares.

The effect of a change in the markup can be obtained by differentiating (22):

(23) $$\frac{\partial s_L}{\partial \mu_t} = -\frac{1}{{\mu_t}^2} + \varepsilon(1-\alpha)\left(\frac{1}{\mu}\right)^{\varepsilon+1}\left(\frac{(1-\alpha)A_{K,t}}{R_t}\right)^{\varepsilon-1}$$

While (23) appears ambiguous, our numeric analysis concludes that for appropriate normalizations of the technology to capital-price ratio (A_k/R) and realistic values for the elasticity as well as the markup, ensuring that (22) produces a feasible value for the labor share, the effect of a markup change on the labor share is indeed negative. Table 3 below summarizes how the different variables in our model affect the labor share for a given elasticity of substitution between capital and labor.

Table 3

	Effect on the labor share, ceteris paribus		
Variable	$\varepsilon < 1$	$\varepsilon > 1$	$\varepsilon = 1$
Increase in the markup	*Likely negative*	*Likely negative*	*Negative*
Increase in capital-augmenting technology	*Positive*	*Negative*	*None*
Increase in the price of capital	*Negative*	*Positive*	*None*

5. Estimating the markup

Hall (1988) proposes an intuitive method for estimating the markup. His starting point is the famous equation derived by Solow (1957) to measure what is now known as the 'Solow residual', or total factor productivity (TFP) growth. Where the Solow residual states that any increase in output without a corresponding increase in inputs must be the result of TFP growth, Hall implicitly claims that any increase in output valued at market prices without a corresponding increase in the price of inputs or TFP growth must be the result of firms exercising their market power by way of increasing markups.

In the presence of a markup, production factors are paid less than their marginal product, which brings us to an essential but tricky concept: The separation between capital income and monopoly rents. Since the profit of a firm contains both the income accruing to the owners of the capital the firm employs as well as any monopoly rents, we simply do not know what share of corporate profits is the result of market power. It is also virtually impossible to measure the degree of substitutability as perceived by consumers between all products in the economy. We rely on an alternative method to measure the income share that accrues to capital, which is based on the opportunity cost of capital to the firm.

To estimate the markup, Hall (1988) relies on instrumental variables for an exogenous output shock not caused by technological progress. However, the quality of these instruments has been disputed and Hall's findings have been criticized. Roeger (1995) extends Hall's method using a dual price-based measure of the Solow residual. By differencing the two residuals, technological change is eliminated along with the need for IV estimation. Our presentation of Roeger's method draws heavily on Hylleberg and Jørgensen's (1998) parsimonious and intuitive analysis.

As previously, we define the markup as the ratio between price and marginal cost.

(24) $$\mu_t = P_t/MC_t$$

The returns to scale parameter, λ_t, is the ratio between average and marginal cost:

(25) $$\lambda_t = AC_t/MC_t$$

Where the average cost is defined as:

(26) $$AC_t = [W_t L_t + R_t K_t]/Q_t$$

Where Q_t is real value added. Combining the three equations above, we get:

(27) $$\mu_t[W_t L_t + R_t K_t] = \lambda_t P_t Q_t$$

To simplify our estimation, we now assume the markup and the returns to scale parameter to be time-invariant. We will consider the implications of this assumption later. To (approximately) express equation (27) as growth rates, we take logarithmic differences and rearrange:

(28) $$W_t L_t(\Delta l_t + \Delta w_t) + R_t K_t(\Delta k_t + \Delta r_t) = \frac{\lambda_t}{\mu_t} P_t Q_t(\Delta q_t + \Delta p_t)$$

Dividing by $P_t Q_t$ and denoting factor income shares as $\alpha_t = W_t L_t/P_t Q_t$ and $\beta_t = R_t K_t/P_t Q_t$ we get:

(29) $$\alpha_t(\Delta l_t + \Delta w_t) + \beta_t(\Delta k_t + \Delta r_t) = \frac{\lambda_t}{\mu_t}(\Delta q_t + \Delta p_t)$$

Note that (27) implies that $\frac{\lambda_t}{\mu_t} = \alpha_t + \beta_t$, or equivalently $\beta_t = \frac{\lambda_t}{\mu_t} - \alpha_t = (\frac{\lambda_t}{\mu_t} - 1) + (1 - \alpha_t)$. Inserting this expression into (29) and rearranging yields:

(30) $$(\Delta q_t + \Delta p_t) - \alpha_t(\Delta l_t + \Delta w_t) - (1-\alpha_t)(\Delta k_t + \Delta r_t) =$$

$$= \left(\frac{\lambda_t}{\mu_t} - 1\right)[(\Delta q_t + \Delta p_t) - (\Delta k_t + \Delta r_t)$$

(30) is the equation originally estimated by Roeger (1995). The coefficient to be estimated corresponds to the Lerner index under the assumption of constant returns to scale, i.e. $\lambda_t = 1$. The Lerner index, $B \in (0,1)$, is a measure of market power. However, estimating (29) has been shown to give nonsensical results, with estimates of the Roeger coefficient being out of bounds as well as implying negative income shares for capital (Hindricks et al, 2000). To alleviate these problems, we rearrange (30) and define the following shorthand notations:

$$\Delta y_t = (\Delta q_t + \Delta p_t) - \alpha_t(\Delta l_t + \Delta w_t) - (1-\alpha_t)(\Delta k_t + \Delta r_t)$$

$$\Delta x_t = (\Delta q_t + \Delta p_t) - (\Delta k_t + \Delta r_t)$$

This allows us to write (30) as:

(31) $$\Delta x_t - \Delta y_t = \left(\frac{\lambda_t}{\mu_t}\right)\Delta x_t$$

Rearranging (31) yields our estimating equation, with an added error term:

(32) $$\Delta x_t = \frac{\mu_t}{\lambda_t}\Delta z_t + \varepsilon_t$$

$$\Delta z_t = \Delta x_t - \Delta y_t = \alpha_t[(\Delta l_t + \Delta w_t) - (\Delta k_t + \Delta r_t)]$$

Under our assumption of constant returns to scale, our estimates correspond directly to the markup. However, as Hylleberg and Jørgensen (1998) argue, the assumption of a constant markup to returns to scale factor is a strong one, especially if (32) is estimated using a large number of periods. Incorporating changes in the markup and the returns to scale factor gives us:

$$\Delta x_t = \frac{\mu_t}{\lambda_t}\Delta z_t + u_t \quad , \quad u_t = \Delta\mu_t - \Delta\lambda_t + \varepsilon_t$$

Hylleberg and Jørgensen (1998) show that the structure of the error term u_t will produce biased and inefficient OLS estimates. They suggest estimating (32) with an added constant and Newey-West (1987) robust standard errors to partially address the bias. However, as it stands we cannot make any inference regarding the size and direction of the potential bias. Estimating (32) for relatively short periods free of major structural changes should serve to increase the quality of our estimates.

6. Data

We estimate the markup for a sample of U.S. industries as well for the private sector as a whole using data from 1947-2012. Industry data for real value added, price indices and a quantity index for fixed private assets (capital stock) are all obtained from the Bureau of Economic Analysis (BEA). The wage rate is calculated as total labor compensation divided by hours worked and the labor share of income is total labor compensation divided by total hours worked. As for the opportunity cost of capital, r, we use a simplified version of Hall and Jorgensen's (1967) approach:

(33) $$\chi_t = (R_t + \delta)P_{k,t}/(1-\tau_c)$$

where χ_t is the price of capital, R is the real interest rate, δ is the depreciation rate, $P_{k,t}$ is a common index for the price of investment goods, and τ_c is the effective tax rate for capital gains. We assume a constant depreciation rate of 10%, which is according to Piketty (2014, p.43) a value commonly used for industrialized countries. We use Moody's seasoned Aaa corporate nominal bond yield and deflate it with the GDP implicit price deflator to obtain a measure of the real interest rate. For the price index of investment goods, we use an implicit price deflator for fixed nonresidential investment goods. All of this data is obtained from the Federal Reserve's FRED database. For the tax rate we use the effective capital gains tax rate as calculated by the Tax Foundation[4].

Our industry level analysis is hindered by a change in industry classification systems[5]. Rather than trying to merge the data from before and after the classification change, we divide our industry-level analysis into two periods, 1981-1997 and 2000-2012. The earlier period contains data for 10 industries and the latter contains 15 industries. Table 4 in the appendix describes the average industry labor shares for our two sample periods.

7. Results

To analyze the fall of the labor share in our markup framework, we must obtain the change in the markup. We divide our sample into two periods, 1981-1998 and 1999-2012, and estimate the respective markup for private industries. The dividing year is chosen because it best corresponds to the beginning of the observed nine percent decline in the labor share (see figure 1) as well as the observed decrease in the price of capital. While any structural changes affecting the labor share did not occur in a single year, our model dictates that we capture the concurrent change in the labor share, the change in the markup, and the change in the price of capital as fixed numbers. The aforementioned sampling periods are a deliberate choice and our results are only marginally affected by shifting the dividing year in either direction. 1981 is selected as the starting point because the price of capital remained stationary during the 80s and 90s (see figure 3). As our estimation assumes a constant markup over time, we want to estimate the markup during a period without major structural changes in any of our variables. The result from our estimations of equation (32) is presented in table 5. We note a fairly significant 12 percent increase in the markup between the two periods.

As a robustness check, we augment our Newey-West estimations with a Bayesian approach. Formulating (32) as a time-varying parameter state-space model, we get the following observation and state transition equations, respectively:

$$\Delta x_t = \mu_t^{AC} \Delta x_t + u_t$$

$$\mu_t^{AC} = \mu_{t-1}^{AC} + v_t$$

The state-space model is recursively estimated using the Kalman filter (Kalman, 1960). To allow for permanent changes in the level of the markup, we model the state transition equation as a random walk. The filtered state predictions ($\hat{\mu}_{t|t-1}^{AC}$) correspond to a series of estimates of the markup. An advantage of the state space model is that the Kalman filter gives us a new prediction for the markup every year, conditional on previous observations. The markup as predicted by the Kalman filter is presented together with the two-period regression in table 5. Figure 4 in the appendix plots the filtered state predictions along with a rolling regression of equation (32). Both estimation methods indicate that the past decade have been one of increasing markups.

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[4] A non-partisan research think tank, based in Washington, D.C.

[5] The Standard Industrial Classification (SIC) system was used until 1997 for most series. From 2000 onwards, industries are classified according to the North American Industry Classification System (NAICS).

Table 5: Markup estimations (U.S. private industries)

Estimation method		1981-1998	1999-2012
Newey-West	Constant	0.004 (0.004)	0.005 (0.003)
	$\hat{\mu}^{AC}$	1.64** (0.096)	1.83**# (0.14)
State space	$\hat{\mu}^{AC}$ (end of period)	1.72**	1.83**+
	$\hat{\mu}^{AC}$ (average)	1.71	1.77

Standard errors in parentheses. *: significant at the ten percent level, **: significant at the one percent level, +: change compared to previous period is significant at the five percent level under a Student's t sampling distribution, #: change compared to previous period is significant at the ten percent level.

Table 6: Industry markups

1981-1997 Industry	$\hat{\mu}^{AC}$	2000-2012 Industry	$\hat{\mu}^{AC}$
Agriculture	1.98*	Agriculture	1.88 *
Mining	4.56**	Mining	8.05**+
		Utilities	3.87**
Construction	1.06**	Construction	1.55**+
Manufacturing Durable goods	1.04**	Manufacturing Durable goods	2.08**+
Manufacturing Nondurable goods	1.82**	Manufacturing Nondurable goods	2.48**
Wholesale trade	1.57**	Wholesale trade	1.98**
Retail trade	1.71**	Retail trade	1.75**
Finance, insurance, and real estate	3.25**	Finance and insurance, real estate, rental and leasing	2.90**
Services	1.23**	**Services**	1.56**+
		Information	2.53**
		Professional and business services	1.25**
		Educational services, health care and social assistance	1.10**
		Arts, entertainment, recreation, accommodation, and food services	1.69**
		Other services, except government	1.32**
		Transportation and warehousing	1.49**
Weighted average markup	1.91	**Weighted average markup**	2.17

Cells contain the Newey-West parameter estimate from equation (32) with an added intercept. All estimated intercepts have an absolute value of less than 0.05, most are insignificant.
*: significant at the ten percent level **: significant at the one percent level +: change compared to previous period is significant at the five percent level.

We also perform industry level estimations of the markup (see table 6). Because the Bureau of Economic Analysis switched industry classification systems around the turn of the century, many industries are not comparable across our sample, forcing us to shift our preferred sub-sampling. We estimate the industry level markups for the period 1981-1997 and 2000-2012. Our results suggest an increase in the markup for all industries except for finance, insurance, and real estate, although the increase is significant only for four industries. We would like to issue a word of caution regarding the industry estimates, as our data may not be of adequate quality. The lack of industry specific capital prices may bias the result, particularly in capital-intensive industries. Our way of accounting for the labor income of the self-employed may also be inadequate for some industries, such as construction and agriculture where the self-employed are arguably earning less on average compared to the employed.

While we cannot judge the credibility of our estimates, they do reaffirm our preconceived notions about certain industries. The finance and information sectors stand out as having relatively high markups. Trade, education, and healthcare, on the other hand, seem to adhere to low markups, possibly due to high levels of competition and many non-profit actors, respectively. Furthermore, our markup estimates for different industries are in the same order of magnitude as the results obtained by Roeger (1995). He finds values very similar to ours for construction, durables, and nondurables (1.25, 2.12 and 1.92, respectively), rendering some credibility to our estimates.

Finally, one should note that our assumption of constant returns to scale, while realistic for the entire private sector, is likely to be violated on the industry level. Mining and utilities, for example, are usually characterized by very high fixed costs, rendering the existence of increasing returns to scale very likely. This hypothesis is backed up by the fact that the weighted average markup, weighted by the industries' relative contribution to the value added of the private sector, are relatively high for both periods considered in table 6: 1.91 and 2.17, respectively. These two values are somewhat higher than our estimated markups on the aggregate level (see table 5)[7]. It is likely that this discrepancy can be attributed to the fact that some of our estimated industry markups are upward biased because of the existence of increasing returns to scale. This would explain the relatively high markups we find for mining and utilities, for example.

The question concerning the magnitude of the returns to scale factor is ultimately a matter of empirics, but it is beyond the scope of this paper. As agued above, we rely on the necessary assumption of constant returns to scale since we cannot jointly estimate the returns to scale factor and the markup. However, one should note that our findings of increasing markups from period 1 to period 2 remain valid even with the existence of returns to scale if the returns to scale factor is roughly time-invariant.

8. Predicting the change in labor share

Taking the model to the data, we insert the observed changes in the markup into our model. Our standard Newey-West regression model predicts an 11.6 percent increase in the markup from 1.64 in the first period to 1.83 in the second period. As for our state space model, we compare the average of our state prediction series for 1981-1998 to the value for 2012 rather than the average during 1999-2012. We make the same argument as for the labor share: Since the parameter seems to have been on

[7] The different industries used to calculate the weighted average markup for the first period do not add up to 100 percent of the private sector since transportation and public utilities are excluded due to conflicting classifications. Furthermore, the weighted average markup and the estimated markup for private industries do not exactly cover the same time period. The latter include one additional year for period 1 and two additional years for period. The missing years in the estimation of industry markups are due to the change of the industry classification system by the BEA.

an upward trend during the last decade, using averages does not reflect the true nature of change. Using these values, we note a 7.1 percent increase in the markup. Given our estimated changes in the markup, how much of the change in the labor share can we explain? Using equation (20), we can predict the change in the labor share given the initial level and change in the markup, the elasticity of substitution between labor and capital, the change in the price of capital, and the change in capital-augmenting technology. In the case of unit elasticity, the production function is Cobb-Douglas and the labor share is then purely a function of the markup.

As we cannot find any credible measure of capital-augmenting technology, we will henceforth assume it to be zero. This assumption derives some support from Acemoglu (2003) who finds that, along the economy's balanced growth path, technological change must be purely labor-augmenting in the case of an elasticity of substitution smaller than one. Capital-augmenting technological change will thus only occur if the economy deviates from its long-run balanced growth path. Klump et al. (2007) provide some empirical evidence for Acemoglu's claim since they find the elasticity of substitution to be significantly below one, typically in between 0.5 and 0.7, for the U.S. economy over the period 1953 to 1998. Jones (2003), on the other hand, suggests that the long-run production function is likely to be Cobb-Douglas, corresponding to unit elasticity. In this case, technological change is presumed to be Hicks-neutral and is assumed to leave the labor share unaffected.

Karabarbounis and Neiman's (2013) finding of an elasticity of 1.25 stands out against the background of previous research. For elasticities above unity, technological change can be capital-augmenting (Acemoglu, 2003), which would invalidate our assumption of $\hat{A}_K$ being equal to zero. But as we shall see, the impact of $\hat{A}_K$ may be negligible in a high markup setting.

We also calculate the change in the price of capital. Figure 3 in the appendix shows that the price trend seems to have shifted between our two estimating periods. A simple unit root test confirms that the price remained stationary during 1981-1998. The early years of the new millennium saw a significant drop after which the price has remained stationary around a new mean. The decrease in the average price from 1981-1998 to 1999-2012 is about 20 percent.

Table 7: Predicted changes in the labor share

		Elasticity, ε			
	Change in R	0.5 (CES)	0.75 (CES)	1 (CD)	1.25 (CES)
Newey-West ($\hat{\mu} = 11.6\%$)	$\hat{R} = 0$	-10.63% (120%)	-10.53% (119%)	-10.43% (117%)	-10.33% (116%)
	$\hat{R} = -20\%$	-10.24% (115%)	-10.33% (116%)	-10.43% (117%)	-10.53% (119%)
State Space ($\hat{\mu} = 7.1\%$)	$\hat{R} = 0$	-6.58% (74%)	-6.58% (74%)	-6.59% (74%)	-6.60% (74%)
	$\hat{R} = -20\%$	-6.62% (74%)	-6.60% (74%)	-6.59% (74%)	-6.57% (74%)

The first cell number is the predicted change in labor share (percentage points). The second number is the share of the observed change in the labor share that is accounted for by our predictions.

We predict the change in the labor share using four different values for the elasticity parameter ε, with and without the observed change in the price of capital. Our calculations are presented in table 7 above. The predictions are highly sensitive to changes in the markup, but are relatively unaffected by assumptions about the production function (ε) and changes in the price of capital.

From the first to the second period, the predicted decrease in the labor share varies from about -10.33 to -10.63 percent for different elasticities if we assume the change in the price of capital to be zero (see row 1 in table 7). The model predictions also do not change substantially if we control for the change in the price of capital. More specifically, the predictions change by only 0.4 percentage points at the most for the Newey-West estimates and the change is hardly noticeable for those obtained with the state space model. This is somewhat surprising since it shows that the labor share is relatively insensitive to changes in the price of capital. It is in direct contradiction with the results obtained by Karabarbounis and Neiman (2013) who find that a large part of the falling labor share can be attributed to the fall of the price of investment goods. Given our estimated values of the markup, our model thus predicts that the biggest part of the change in the labor share can indeed be attributed to changes in the markup. The difference between our results and those obtained by Karabarbounis and Neiman mainly stems from the fact that we employ a much higher value for the markup. Given our empirical estimates obtained in the previous section, we believe that such a high value for the markup is justified.

As for the accuracy of the model, we can see that the predicted change in the labor share somewhat exceeds the actual change by about 15 to 20 percent for the rolling regression estimates. Our model thus slightly overestimates the change in the labor share, but the difference between the actual and the predicted value is relatively minor. As for the results obtained with the state space regression, we see that we now slightly underestimate the change in the labor share by about 25 percent. Again, the model accurately predicts the direction of change in the labor share and the difference between the actual and the predicted change is relatively small.

9. Discussion

Our ultimate goal is to relate the recent of the labor share to changes in the markup. We estimate the markup based on a method suggested by Hall (1988), using the relationship between value added and input prices. We perform the estimation for the entire private economy as well as for individual industries. Our results suggest that markups have indeed been rising during the last two decades, and especially in the last ten years or so.

We use our markup estimates to calculate the change in the markup, which we then plug into the theoretical model based on Karabarbounis and Neiman (2013). This gives us a prediction to what extent the fall of the labor share can be attributed to rising markups. Our model suggests that a very large portion of the change in the labor share can be explained by rising monopolization and that the fall of the price of investment plays a very marginal role. This finding is in direct contradiction with Karabarbounis and Neiman (2013) who attribute a much larger role to the declining price of capital. These contradictory results can be explained by the fact that they use a markup only slightly greater than 1, implying a much smaller rent share of GDP. However, our empirical findings suggest that monopoly rents and the corresponding markup are significantly larger. In the case of a high initial markup, our model suggests that changes in the price of capital as well as capital-augmenting technological change only have a marginal impact on the labor share, giving rise to our result that the fall of the labor share can largely be attributed to rising monopoly power.

However, there are several reasons for a cautious interpretation of our results. Roeger's (1995) method represents a significant improvement over the instrumental variable approach used by Hall

(1988). Given the existing literature on estimating markups, we employed the most promising and most widely utilized method that was feasible given available data. For that reason, there is not much more we can do about the estimates we obtained other than relying on the previously mentioned academic papers. Roeger's method is intuitively appealing, but a successful application is highly dependent on data quality. Some of the variables we use are notoriously elusive, such as the quantity and price indices for the capital stock. Statisticians have a very hard time to adjust for technological improvements and quality changes while constructing these indices. For that reason, we are working with proxy variables rather than the 'true' variables and it is possible that they are seriously flawed.

At its core, Roeger's method is about separating the true cost of capital from any economic rent. This idea has come under heavy criticism. Filipe and McCombie (2001) argue that the cost of a unit of capital to a firm can be none other than the profit the firm expects to derive from that unit. Using "the profit rate" and the fact that the value added is the value of the firm's production at market prices (i.e. revenue), they argue that Roeger is estimating a simple accounting identity. They conclude that any markup estimate different from unity is the result of measurement error. By following the Hall-Jorgenson (1967) method of constructing a price index for capital, we are implicitly assuming that the opportunity cost of capital to a firm is different from the profit rate. However, we have made a number of assumptions to calculate the opportunity cost of capital, regarding the relevant interest rate, taxation and depreciation.

A known property of Roeger's method is that the implied income share of capital is very low (Hindriks et al, 2000). Given our estimated markups, the labor share and the rent share take up close to 100 percent of GDP, leaving only a marginal share to capital. While the distinction between rents and capital income is difficult to pin down, as previously argued, it is nonetheless problematic to assume a value for the capital share close to zero. Assuming a total capital stock equal to 400 percent of the economy's annual income and an average interest rate of 4%, for example[8], the capital share of income should be 16 percent of GDP (400*0.04), thus implying a somewhat lower markup and a lower associated rent share than what we find above.

The upward bias on the industry level is, as previously argued, possibly the result of increasing returns to scale, especially in industries like mining and utilities. The matter of returns to scale becomes somewhat more complicated on the aggregate level. Using aggregate estimates, Basu and Fernald (1997) find some evidence of increasing returns to scale for the private economy. However, when applying the same method on the industry level and then calculating the weighted average across all industries in the economy, the private economy is suddenly characterized by constant returns to scale. These contradictory results are thought to be an unfortunate side effect of aggregation (Basu & Fernald, 1997). Given their findings, it is possible that the relatively high markups we find for private industries are biased upwards because of the existence of increasing returns to scale. However, we are unable to correct for this potential source of bias without a reliable estimate for the returns to scale factor. Nevertheless, our predictions ultimately rely on the change in the markup. If the returns to scale factor is roughly time-invariant, then our estimated changes in the markup are correct even if we overestimate the level of the markup.

It is also possible that the upward bias in our markup is due to our implicit assumption of constant markups (Hylleberg & Jørgensen, 1998). The whole point of this paper, however, is to demonstrate that markups are not constant over time. Our estimates could thus be unreliable if the markup fluctuated wildly within our chosen time intervals. In our standard regression estimation, a smaller sample reduces the risk of changes in the true parameter value with the estimation period, but leads to higher standard errors and thus less reliable estimates.

[8] These numbers are loosely based on Piketty's empirical studies (Piketty, 2014).

One should also be aware that we have not de facto established causality per se. Our theoretical model suggests a link between markups and the labor share. All else equal, a rise in market power leads to lower labor compensation. However, it is just as plausible that the causal effect is reversed, that is, a decline in the labor share leads to a higher markup for firms. In that case, markups are rising because firms are paying a lower share of income to labor, for whatever reason.

Finally, our result that rising markups can explain a large part of the decline in the labor share is not in contradiction with a lot of previous findings, such as Stockhammer (2013) who attributes the fall of the labor share to financialization, or weakened labor unions, as argued by Fichtenbaum (2011). There are several phenomena (summarized in table 2) that can lead to an increase in the monopoly power of firms. One can thus characterize rising markups as a proximate cause of the decline in the labor share, while some other structural change or mechanism could be the ultimate cause. Consequently, the findings of Stockhammer (2013) and Fichtenbaum (2011), respectively, are not in contradiction with our results.

Caveats aside, it is interesting to consider the predictions of our model. Aside from attributing a large part of the fall of the labor share to rising markups, our model also suggests that a high initial level of the markup reduces the importance of capital in the sense that the price and productivity of capital have little impact on the labor share (see equation (20)). Put differently, our model suggest that firms operating in a high markup environment will be unwilling to substitute labor for capital regardless of the degree of substitutability or the price of capital (see table 7). The intuition could be that under a high markup, firms simply lack the incentive to change their production process, or that they use cheaper and more attractive capital as leverage to lower real wages instead of actively substituting labor for capital. However, these conclusions are a little beyond the scope of our simple model.

10. Conclusion

We find substantial evidence of rising markups in U.S. private industries over the last two decades, using both the Newey-West estimation of equation (32) and our state-space adaptation. Using the Newey-West estimations, we find that the predicted fall of the labor share is roughly 20 percent higher than the actual change that occurred during our chosen time period. The state-space estimates, on the other hand, yield a predicted fall of the labor share that is 25 percent lower than the actual change. While the magnitude of the change differs, the direction does not: Markups in U.S. private industries have been rising over the last two decades, as emphasized in figure 4 in the appendix. This is also backed up by our industry estimates, which confirm that markups have been rising across industries, forming an increase in the aggregate markup of the U.S. private sector.

While our theoretical model predicts that rising markups lead to a lower labor share, we cannot make any conclusions regarding causality. Consider the case of unit elasticity (Cobb-Douglas). For equation (21) to hold, a rise in the markup implies a fall of the labor share. Conversely, a declining labor share implies a rise in the markup. It is thus equally plausible that the fall of the labor share, for whatever reason, led to rising markups for firms, and not the other way around. Finally, our study does not identify what caused the rise in the markup. As previously argued, there are several mechanisms by which the labor share could fall via a rising markup.

It is clear that the substantial fall of the labor share in the U.S. (and also in other industrialized countries) has enormous economic consequences and that policy makers should be made aware of this trend. The middle class and the economically disadvantaged are reliant on labor compensation. A fall of the labor share through a rising markup would thus lead to a more unequal society as asset owners gain at the expense of labor.

As for economic policies to address the problem of the falling labor share, we are very careful to offer recommendations since we have not identified any ultimate causes. The government would have to implement policies that strengthen labor market institutions if rising markups were the result of the weakening of labor unions. On the other hand, if rising markups were the result of increased market concentration, a pure competition effect, then governments would have to be more stringent on mergers and acquisitions and antitrust laws.

Finally, the phenomenon called financialization can also lead to a higher markup by decreasing the bargaining power of labor, for example. This is even more difficult to address since most financial activities have a global scope, forcing policies to be implemented via international cooperation. Future academic work should thus further identify the causes that have led to the recent rise in markups in U.S. industries as well as develop improved methods of estimating market power on an aggregate level. Furthermore, it is of interest to know if other industrialized countries experiencing a fall of the labor share display the same pattern of rising markups as in the U.S.

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11.1. Data Sources

- Bureau of Economics Analysis (BEA): http://www.bea.gov/
- Federal Reserve Economic Data (FRED): http://research.stlouisfed.org/fred2/
- Tax Foundation: http://taxfoundation.org/

12. Appendix

TABLE 1 2000-2012

Industry	Within	Structural
Agriculture	-0.20	0.08
Mining	-0.24	0.40
Utilities	-0.06	-0.01
Construction	0.03	-0.53
Manufacturing - Durable goods	-0.74	-1.62
Manufacturing - Nondurable goods	-0.92	-0.16
Wholesale trade	-0.40	-0.07
Retail trade	-0.25	-0.71
Transportation and warehousing	-0.32	-0.08
Information	-0.72	0.00
Finance and real estate	-0.20	0.01
Professional business services	-0.28	1.07
Educational services, health care and social assistance	-0.10	1.41
Arts, entertainment, recreation, accommodation and food services	0.02	0.03
Other services, except government	0.21	-0.38
Government	0.00	0.66
Sum	-4.19	0.09
Within + Structural	-4.10	
Change in aggregate labor share (percentage point change in trend value)	-4.19	

Table 4: Average industry adjusted labor shares

1981-1997		2000-2012	
Industry	Labor share	Industry	Labor share
Agriculture	51.7 %	Agriculture	50.3 %
Mining	30.7 %	Mining	24.4 %
		Utilities	27.4 %
Construction	88.9 %	Construction	80.3 %
Manufacturing Durable goods	75.3 %	Manufacturing Durable goods	63.7 %
Manufacturing Nondurable goods	61.9 %	Manufacturing Nondurable goods	41.0 %
Wholesale trade	59.6 %	Wholesale trade	52.1 %
Retail trade	66.3 %	Retail trade	60.8 %
Finance, insurance, and real estate	26.3 %	Finance and insurance, real estate, rental and leasing	26.4 %
Services	80.3 %		
		Information	41.1 %
		Professional and business services	79.9 %
		Educational services, health care and social assistance	88.7 %
		Arts, entertainment, recreation, accommodation, and food services	64.8 %
		Other services, except government	80.8 %
		Transportation and warehousing	68.0 %

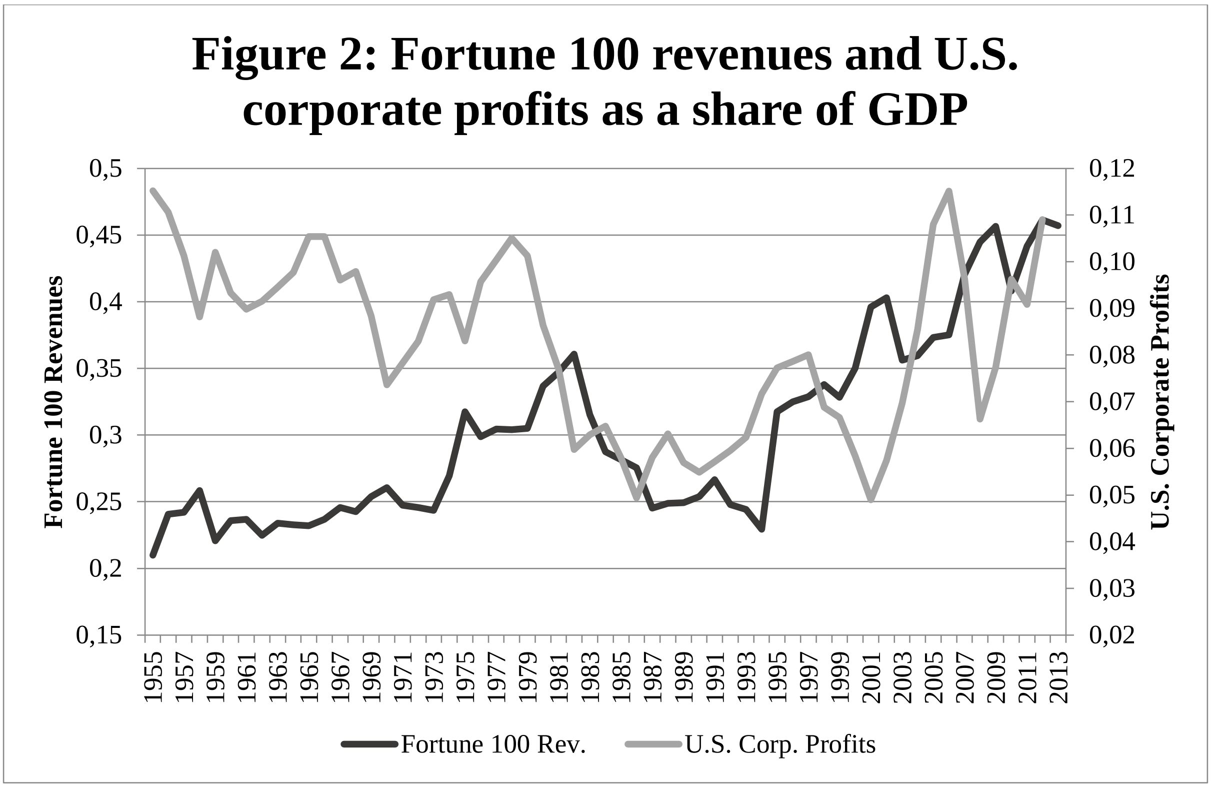
Figure 2: Fortune 100 revenues and U.S. corporate profits as a share of GDP
Fortune 100 Revenues
U.S. Corporate Profits
0,5
0,45
0,4
0,35
0,3
0,25
0,2
0,15
0,12
0,11
0,10
0,09
0,08
0,07
0,06
0,05
0,04
0,03
0,02
1955
2013
Fortune 100 Rev.
U.S. Corp. Profits

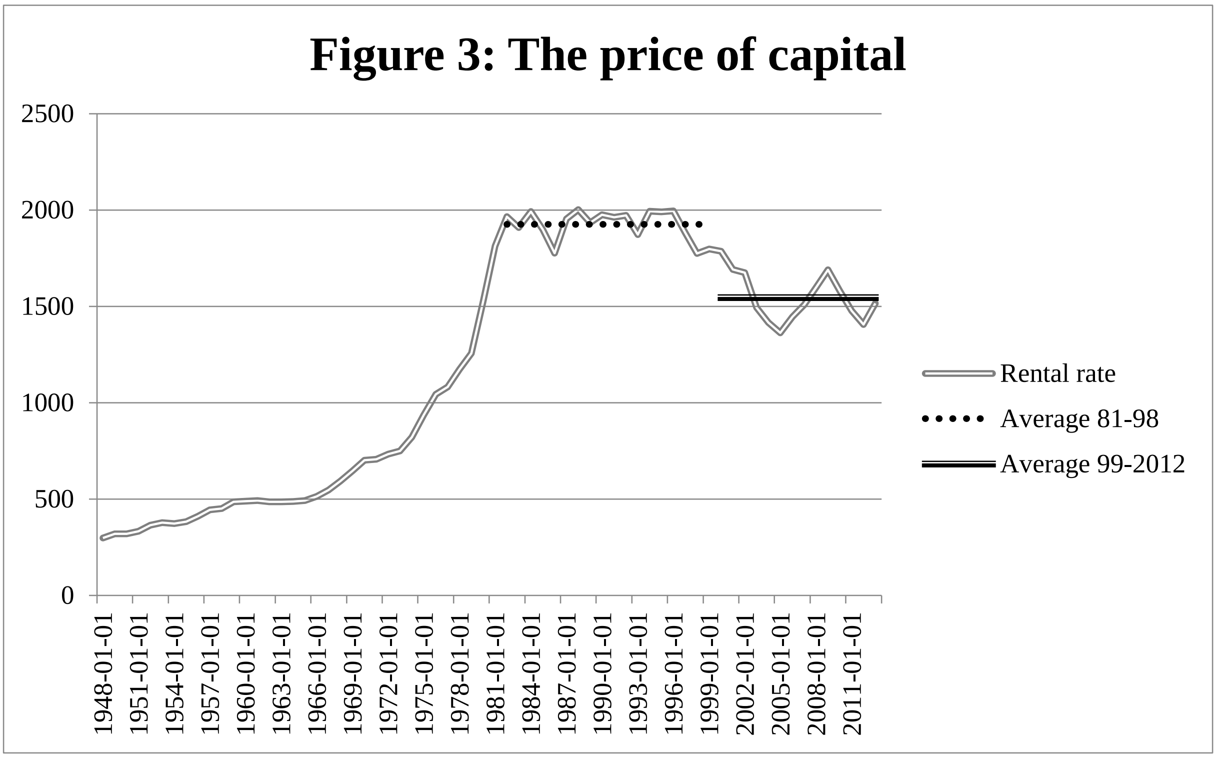
Figure 3: The price of capital
2500
2000
1500
1000
500
0
1948-01-01
2011-01-01
Rental rate
Average 81-98
Average 99-2012

Figure 4: Estimated markups with 95 percent C.I.