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Abstract

We estimate constant returns or slightly decreasing returns at the industry level in the private U.S. economy over the past 30 years, using two separate industry datasets. An intuitive identity linking returns to scale, the markup, and the profit rate, gives an implied markup of approximately12 percent, smaller than the estimates in the recent literature ranging from 15 – 40 percent. Put differently, given our estimated profit rate, large markups imply strongly increasing returns, which are not evident in the aggregate data. These findings suggest that approximately constant returns to scale in the U.S. economy are consistent with a relatively small aggregate markup in the post-1990 period.

Key words: Returns to scale, profit rates, markups
JEL classification: E22, E32

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1 Introduction

We revisit an earlier literature that used a production function-based approach with industry data to estimate returns to scale in the U.S. economy and, from that, inferred estimates of the typical markup of price over marginal cost (Basu and Fernald (1997)).[1] The consensus view that emerged from this literature is that returns to scale in the typical U.S. industry are approximately constant, and imply a relatively small aggregate (value added) markup of perhaps 10 percent. Our updated industry estimates in this paper find that these conclusions are only modestly affected, although profit rates do appear to have risen.

Recently, there has been a growing debate on whether market power—measured as the price-marginal-cost markup—has risen since the late-1980s (De Loecker and Eeckhout (2018), Syverson (2019), Basu (2019)). Rising market power potentially has implications for a variety of macroeconomics topics, for example, understanding the secular trends in factor income shares, developing macroeconomic models, and designing appropriate regulatory responses. In a widely noted recent paper, De Loecker and Eeckhout (2017) show using Compustat data that the average gross-output markup has increased from 18 percent in 1980 to 67 percent by 2014, with an average close to 40 percent since 1987.[2] But Traina (2018) finds that when accounting and management expenses are included in the costs, the average markup remains flat at approximately 15 percent. The point estimate in Hall (2018), using BLS KLEMS productivity data, finds that the average markup grew since 1987 and is about 31 percent.[3] The previous consensus value of the markup lies outside this debated range of 15 to 40 percent.

In this context, updated estimates of aggregate returns to scale are informative for macroeconomists for at least two reasons. First, the data used in previous studies either does not overlap or has a relatively short overlap with the period of the debated increase in the markup. In particular, the sample period is 1958 to 1989 in Basu and Fernald (1997) and 1953 to 1984 in Burnside (1996). Basu, Fer-

[1]This literature builds on Hall (1988). Some early contributions are Hall (1990), Caballero and Lyons (1992), Bartelsman, Caballero and Lyons (1994), Basu and Fernald (1994), Basu and Fernald (1995b), Burnside, Eichenbaum and Rebelo (1995), and Burnside (1996).

[2]De Loecker and Eeckhout (2018) find that average global markup increased from 10 percent in 1980 to 60 percent in 2016.

[3]The T-statistic on Hall's markup trend is only 1.2, so the evidence is not that strong.

nald and Kimball (2006) present the estimates of returns to scale that control for utilization based on the sample period 1949 to 1996.[4] So it is unclear how the implied markup based on the estimates of aggregate returns to scale in the post-1990 period compares with these recent markup estimates.

Second, the rate of pure economic profits in the aggregate business sector has increased in recent decades. By our estimate, this rate averages about 11 percent of business-sector nominal output over the post-2000 period. Our estimate of this profit rate is based on an aggregate approach using a weighted average of the required equity return and the required bond-market return to measure the cost of capital.[5] Relatedly, the aggregate share of accounting profits in the non-financial U.S. corporate sector measured as the ratio of aggregate profits to gross value added, has increased by 12 percentage points from 1984 to 2014 (Barkai (2018)). Previously, Basu and Fernald (1997) estimated a small average profit rate of about 3 percent for a typical industry in the 1958 to 1989 period and noted that *"..economic profits do not appear large in any of our measures"*. They combined this small profit measure with the estimated returns to scale to determine the aggregate markup of 10 percent. Given the increase in estimated profit over the past three decades, however, the magnitude of the implied markup would be different for any particular estimate of the aggregate returns to scale, especially the one for the post-1990 data which is not yet available.

The main contribution of our paper is to fill these gaps in the literature. We provide estimates of the aggregate returns to scale in the U.S. economy for both the pre- and post-1990 periods. Using these estimates, along with our new estimates of the profit rate, we then draw implications to inform the ongoing debate on the rise in market power.

Following Basu, Fernald and Kimball (2006), we estimate industry-level returns to scale using an Instrument Variables (IV) approach and two separate annual datasets that both span the U.S. business sector. The first is the U.S. component of the World KLEMS (hereafter US KLEMS) project (Jorgenson, Ho and Samuels (2017)) that follows the North American Industry Classification System (NAICS) replacing the SIC system in 1997, and covers the period 1947 to 2014.[6] This dataset consists of 61

[4] Chang and Hong (2006) follow Basu, Fernald and Kimball (2006) specification and estimate returns to scale for the 1958 to 1996 period.

[5] We present the details in section 4.1 below. While we have not estimated profits at the industry level, it is likely that our estimate of the aggregate business profit rate is consistent with the average profit rate across the industries. These estimates correspond to Case-Π in Karabarbounis and Neiman (2018).

[6] Based on Jorgenson, Ho and Samuels (2017), March 2017 release available at http://www.worldklems.net.

industries that cover the entire private economy. The second dataset is the Jorgenson (2008)'s 35 Sector KLEM (hereafter 35KLEM) which is a sectoral input-output database.[7] It covers 35 sectors at roughly the 2-digit Standard Industrial Classification (SIC) level from 1960 to 2005 and contains information on the value and the price of four inputs (capital (K), labor (L), energy (E) and materials (M)) and the value and price of output for each sector. Relative to 35KLEM, the US KLEMS data cover a longer time period and have increased detail on service industries. However, due to the availability of hours-worked data, the 35KLEM data allows to present estimates for the pre-1989 period. We estimate returns to scale in each industry, and then construct the aggregate weighted-average based on the industry cost shares. We also report the median estimate and average estimates.

In the US KLEMS data, the returns to scale estimates for the 1989-2014 period are 0.93 and 0.99 in the private economy and manufacturing, respectively. Although below one, both estimates are statistically indistinguishable from that value at the 5 percent level of significance, implying approximate constant returns to scale. In the 35KLEM data, the returns to scale estimates for the 1989-2005 period are 0.89 and 1.03 in the private economy and manufacturing, respectively. For the 1960-1988 period, the estimates are 0.94 and 0.96, respectively. Again, we do not reject the hypothesis of constant returns to scale in both sub-samples.

Next, we use an intuitive identity in Basu and Fernald (1997) that connects the aggregate production side of the economy with the market structure side to frame the discussion on returns to scale, markups, and the profit share. Let AC, MC, and P denote the aggregate average costs, marginal costs, and the price, respectively. Then we have

$$\begin{aligned} \frac{AC}{MC} &\equiv \frac{P}{MC} \times \frac{AC}{P} \\ \text{Returns to Scale} &\equiv \text{Markup} \times (1 - \text{Profit Rate}) \end{aligned} \tag{1}$$

where AC/MC is returns to scale, P/MC is the markup, and AC/P can be expressed as (1-Profit Rate). The expression shown in (1) can also be derived from cost minimization under the assumptions of monopolistic competition in the product market and perfect competition in the factor markets.[8] Our estimates of the constant or slightly decreasing returns to scale along with the 11 percent average profit

[7]The dataset is described in Gollop et al. (1987), Jorgenson (1990), and Jorgenson and Stiroh (2000).

[8]This derivation is shown in the Appendix.

rate, gives implied aggregate (value added) markups of under 12 percent. Relative to the previous consensus in the literature, the new implied markup is similar.[9]

Using the three estimates of markups in the recent literature, along with our estimated aggregate profit rate of 11 percent for the sample period, we back out what they imply about returns to scale. This exercise serves as a useful baseline for obtaining returns to scale without any actual estimation using the two-digit industry data. We find that markup estimates in De Loecker and Eeckhout (2017) and Hall (2018) imply relatively large increasing returns of 1.25 and 1.15, respectively. The markup estimate in Traina (2018) gives a value 1.02, implying near-constant returns to scale.

Lastly, we impose the constant returns to scale estimate and the three independent estimates of average markups from the recent literature to back out the implied profit rates.[10] For the average markups in De Loecker and Eeckhout (2017), Hall (2018), and Traina (2018) we obtain 28.5 percent, 23 percent, and 13 percent, respectively. These implied profit rates remain moderate to substantially larger than the 11 percent profit rate we estimate for the post-2000 period. Our findings suggest that approximately constant returns to scale in the aggregate economy are consistent with a relatively small aggregate markup in the post-1990 period.

The rest of this paper is organized as follows. Section 2 presents empirical specification and data. Section 3 presents the results. Section 4 presents the calculation of the aggregate profit rate and discusses the implications for the aggregate markup. Section 5 concludes.

2 Empirical Specification and Data

Following Basu, Fernald and Kimball (2006), the main empirical specification that we estimate as a system of equations for the individual industries is

$$\Delta y_{it} = c_i + \gamma_i \Delta x_{it} + \beta \Delta h_{it} + \epsilon_{it} \tag{2}$$

[9] Ruzic and Ho (2017) use (1) to understand manufacturing plant level data. Their estimates show relatively constant markups but *declining* returns to scale in firm level data, thus rationalizing a rising profit rate. De Loecker and Eeckhout (2018), Syverson (2019), Basu (2019) also use an expression similar to (1) in their discussion of markups.

[10] The assumption of constant returns to scale is ubiquitous in both theoretical models studying markups and profit shares and also in empirical work that seeks to measure these quantities. See, for example, Rognlie (2016, p. 18), Barkai (2018, p. 18-19), De Loecker and Eeckhout (2017, p. 23-26), Eggertsson, Robbins and Wold (2018, p. 26), Karabarbounis and Neiman (2018, p. 3), Brun and González (2017, p. 16-27), Gutiérrez and Philippon (2017), Traina (2018), among others.

where Δy_{it} is gross output growth, c_i is the industry-specific constant, γ_i is the returns-to-scale parameter, Δx_{it} is a cost-share-weighted sum of input growth, Δh_{it} is growth in hours per worker, and β is an estimated parameter constrained to be common within industry sub-groups as in Basu, Fernald and Kimball (2006). Basu and Fernald (1997) estimated equation (2) without the $\beta \Delta h_{it}$ term. Basu, Fernald and Kimball (2006) added this term to control for the contribution of variable factor utilization to output. In their dynamic cost-minimizing model, hours per worker are an observable proxy for the intensity with which factors of production are used. The parameter β is a composite of several underlying parameters and elasticities that link this observable proxy to the underlying unobserved variation in factor intensity. With these controls, the residual ϵ_{it} captures technology change.

Cost-share-weighted input growth, Δx_{it}, is defined as

$$\Delta x_{it} \equiv C_{Kit} \Delta k_{it} + C_{Lit} \Delta l_{it} + C_{Mit} \Delta m_{it} \tag{3}$$

where Δl_{it} is the growth rate of labor input, Δk_{it} is the growth rate of capital input, and Δm_{it} is the growth rate of intermediate inputs of energy, materials, and services. The cost share of input J is computed as $P_J J / TC$ where P_J is the input price (i.e., its wage or required rental rate or, for intermediate inputs, the purchase price of those inputs) and TC is total cost (revenue less pure economic profits).

For the period 1958-1989, Basu and Fernald (1997) found that pure economic profits were small. We find a similar result in Section 4.1. In a world with zero pure profits, TC_{it} equals total revenue, $P_{it} Y_{it}$. As a result, factor shares in cost are equal to factor shares in revenue, and these shares sum to one. Since C_{Lit} and C_{Mit} are observed in the data, we can take C_{Kit} as a residual. Indeed, in both of the datasets we use, the (rental) price of capital input, P_K, is defined so that there are zero profits.

In Section 4.1, we discuss estimates of required payments to capital, which depends on the interest rate, the depreciation rate, the level and growth rate of the price of capital, and the details of the tax code. In aggregate data, we find that up until the 1990s, profits were small. Since then, profits have been somewhat more important. This draft does not estimate required payments to capital at an industry level (we plan to do that soon). In the meantime, we either assume zero profits (in which case (1) shows that markups and returns to scale are the same); or else we simply calibrate the profit rate as a share of revenue, $S_{\Pi it}$. In the latter case, suppose the observed shares of labor and materials in revenue are S_{Lit} and S_{Mit}. The cost shares are then

$$C_{Lit} = S_{Lit} / \left(1 - S_{\Pi it}\right), C_{Mit} = S_{Mit} / \left(1 - S_{\Pi it}\right), \text{and } C_{Kit} = \left(1 - S_{Lit} - S_{Mit} - S_{\Pi it}\right) / \left(1 - S_{\Pi it}\right) \quad (4)$$

As mentioned above, our analysis is based on 35 KLEM and the new KLEMS-type dataset for the U.S. economy from the World KLEMS project presented in Jorgenson, Ho and Samuels (2017). According to Jorgenson, Ho and Samuels (2017), the World KLEMS data are consistent with industry accounts and annual input-output tables published by the Bureau of Economic Analysis (BEA) for 1947-2014. The methodology used to build this data is also consistent with the methodology used by the BEA/Bureau of Labor Studies (BLS) to produce industry level production accounts. The data consist of manufacturing and non-manufacturing industries, with nominal and real time-series on gross output, labor, capital and intermediate inputs from 1947 to 2014. Tables A1 and A2 show the industry classification for both data sets, respectively.

We estimate equation (2) using an IV approach similar to Basu, Fernald and Kimball (2006). We use the updated Ramey-Hall instruments, namely, shocks to petroleum prices, growth rate of real government defense spending, and monetary shocks considered in many studies in the literature. The estimates of returns to scale and markups that we produce apply to gross output. In some macroeconomic models with heterogeneity and with a fully specified production function and input-output networks, these may be the relevant estimates. For macroeconomic models with a representative producer, one typically requires estimates converted to a value-added basis (see Rotemberg and Woodford (1995) and Basu and Fernald (1997)). The relationship is

$$\gamma_i^V = \frac{\gamma(1 - C_{Mi})}{1 - \gamma C_{Mi}} \quad (5)$$

where γ_i^V is the value-added estimate. The relationship is similar for the gross-output to the value-added markup.

3 Results

In this section, we present the aggregate results based on the weighted average of the industry-level estimates. Specifically, we estimate (2) for each industry to obtain the sectoral and total private economy estimates of returns to scale. Following Basu and Fernald (1995a), we obtain the weighted estimates with weights representing industry $i's$ share in the total cost of producing gross output.

Table 1 presents the estimates of returns to scale for the private economy and the sub-sectors for the World KLEMS data over the 1989-2014 period.[11] These aggregated estimates are based on the industry estimates shown in Figure 1. In the US KLEMS data, the weighted estimates are 0.93, 0.99, and 0.92 in the private economy, manufacturing, and non-manufacturing, respectively. Although slightly below one, these estimates are statistically indistinguishable from that value at the 5 percent level of significance, implying approximate constant returns to scale in U.S. production. Over this period, however, the median industry exhibits slightly decreasing returns with estimates smaller than the weighted estimates. The estimated β is positive indicating a positive contribution of utilization to output growth, consistent with the underlying theory.

Table 2 presents the estimates for the 35KLEM data. These aggregated estimates are based on the industry estimates shown in Figure 2. The returns to scale estimates for the 1989-2005 period are 0.89 in the private economy and 1.03 in manufacturing, respectively. For the 1960-1988 period, the estimates are 0.94 and 0.96, respectively. Again, we do not reject the hypothesis of constant returns in both sub-samples. As in the case of US-KLEMS data, the median industry exhibits decreasing returns to scale. Finally, Table 3 presents the estimates over the whole sample. While the median estimate in this case turns out to be higher, 0.96, the weighted average estimate is closer to that in the post-1989 period in Table 2.

We also consider an alternative dummy-variable specification that allows for a change in the estimated coefficients in the post-1989 period. This specification is as follows:

$$\Delta y_{it} = c_i + \gamma_i \Delta x_{it} + \theta_i \times D\Delta x_{it} + \beta \Delta h_{it} + \delta_i \times D\Delta h_{it} + \varepsilon_{it} \tag{6}$$

$$D = \begin{cases} 0 & \text{if} \quad 1960-1988 \\ 1 & \text{if} \quad 1989-2005 \end{cases}$$

Table 4 reports the change in the interaction coefficient. Notably, the change is negative in most industries indicating a decrease in the returns to scale estimate in the latter sample period.

[11] The pre-1989 hours data consistent with 3-digit NAICS is not available hence the estimation is for the post-1989 period.

4 Implications

In this section we use equation (1) and the returns to scale estimates for the post-1990 period to draw implications for the aggregate markup. A key input in doing this using (1) is the profit rate. We first present a detailed discussion of how we estimate profit rates and assess how they have changed over subsamples. Profit rates turn out to be very sensitive to reasonable alternative assumptions about required rates of return. That said, using an average of a bond rate and an equity rate yields rates of pure economic profits/losses that is small in magnitude over the 1947-2018 period. But a range of alternatives consistently yield much larger profits since 2000.

4.1 How large are profits?

A fundamental accounting identity says that a firm's revenues are paid out as income payments to someone. Some or all of those payments cover the costs of hiring inputs. Anything left over is paid as pure profits to the owners of the firm. Omitting time subscripts, the accounting identity for industry i is:

$$P_i Y_i = W_i L_i + \sum_j P_j M_{i,j} + \sum_n R_{n,i} K_{n,i} + \Pi_i \tag{7}$$

In this equation, W_i is the wage, L_i is labor input, and $M_{i,j}$ is the use in industry i of inputs from industry j. There are N types of capital $K_{n,i}$, with corresponding rental rates $R_{n,i}$. Conventional growth accounting typically assumes that pure economic profits, Π_i, are zero. In that case, we can measure payments to capital as a residual—that is, total revenues less payments to labor and materials.

Suppose, however, that we do not want to impose zero profits but we instead want to measure them. In that case, we need to measure the (typically unobserved) rental rate of capital, $R_{n,i}$. Given these rental rates, pure profits are then a residual:

$$\Pi_i = P_i Y_i - W_i L_i - \sum_j P_j M_{i,j} - \sum_n R_{n,i} K_{n,i} \tag{8}$$

Following Hall (1990), Basu and Fernald (1995b), Barkai (2018), and Karabarbounis and Neiman (2018), we can calculate a Hall-Jorgenson user-cost of capital for each type of capital. The equation we implement, following Hall (1990), is:

$$R_{n,i} = \left(r_i + \delta_n - \left(\dot{p}_{K,n}^{expected} - \dot{p}_i^{expected}\right)\right) \frac{(1 - \kappa_n - \tau_n d)}{(1 - \tau_n)} P_{K,n} \tag{9}$$

In this equation, r_i is a real rate of return for the industry, δ_n is the depreciation rate for capital of type n, $\left(\dot{p}_{K,n}^{expected} - \dot{p}_i^{expected}\right)$ is an expected capital gains term for capital of type n in industry i, [12] τ_n is the firm's tax rate, κ_n is an investment tax credit, d is the present value of tax depreciation allowances, and $P_{K,n}$ is the purchase price of capital of type n.

We have not yet implemented this approach for the detailed industries in our datasets. Instead, we follow Barkai (2018) and Karabarbounis and Neiman (2018) and implement it at an aggregate level (thus suppressing the industry subscripts). In particular, we start by estimating profits for the aggregate business sector, using the data in Fernald (2014) which builds quarterly capital services for the U.S. business sector from 16 disaggregated types of capital–mostly measured with a perpetual inventory–and then weights them with user costs to calculate capital services. To derive these weights, Fernald (2014) solves for the implicit real interest rate (in terms of the business deflator) that sets profits in equations (7) and (8) to zero. But, given any exogenously specified real rate of return, we can use equation (9) to estimate the rental rates (user costs), which we then plug into equation (8) to estimate pure profits as a residual.

We consider two measures for the external rate of return. The first is a BBB bond rate. That rate incorporates a modest premium for risk above the yield on long-term Treasuries. The second is based on equity prices, and is the dividend yield on the S&P 500 adjusted for growth. The second approach follows Hall (1990) and Basu and Fernald (1995b).[13]

In the figures that follow, we follow Fernald (2014) and measure expected inflation rates using a smooth moving average, with 12 quarterly lags and 6 quarterly leads. Fernald (2014) took this approach because it gave relatively smooth user-cost weights while allowing for trends in the relative weights over time.) We calculate expected growth for the dividend yield formula using real GDP

[12] Note that we can equally use a nominal rate, with the expected capital gains term specified as $\dot{p}_{K,n}^{expected}$.

[13] The Gordon pricing model assumes dividends grow at rate g and are discounted at rate r. Hence, the price, which equals the present value of dividends, is $P = \left(\frac{D}{r-g}\right)$. Thus, the model implies that $r = \left(\frac{D}{P}\right) + g$. Hall (1990) and Basu and Fernald (1995b) simply used the dividend yield, without adjusting for growth. Hence, the real rates they used were lower than what would have been implied by equity prices. See also Fahri and Gourio (2018).

growth, using the trend estimated from a biweight filter with a smoothing parameter of 48 quarters. The implied real growth rate slows from about 4 percent in the early post-war years to about 2 percent in recent years.

Figure 3 shows the resulting real rates, smoothed as 5-year moving averages. We plot three rates in this picture. The bold blue line shows the zero-profit internal real rate from Fernald (2014). With that rate, payments to capital, labor, and materials exhaust revenue, which would be consistent with zero economic profits at all times. The red line shows the real BBB rate. The orange line shows the real rate implied by the S&P 500 dividend yield.

While all three approaches are defensible, the rates themselves are typically quite different. Early in the sample, the implied equity return from the dividend yield is quite high, close to 10 percent in the early years. The reason is that the dividend yield itself was very high in the late 1940s and early 1950s, peaking at 7.5 percent in July 1950. Moreover, expected growth at the time was around 4 percent. In contrast, the real BBB rate was quite low, close to zero. The internal zero-profit rate was intermediate between the equity and bond rate, and typically remained in that range until about 1980.

After 1980, the BBB rate rises sharply. Indeed, it rises above the equity-implied rate. From the mid-1980s on, the BBB rate and the equity rate remain relatively close together and fall steadily over time. In contrast, the internal rate bottoms out in the early 1980s and then rises fairly steadily to the 2000s and remains quite high in recent years.

In the user-cost formula, if we use an external real rate that is below the internal zero-profit rate, then the estimated profits will be positive. In contrast, if we use a rate that is above the internal zero-profit rate, then estimated profits will be negative. It is clear from the figure that the profit rate will depend on the specific sample used. Profits are very sensitive to this choice because the nominal capital-to-output ratio in the business sector, $\sum_n P_n K_n / P^V V$, averages 2.7 over the 1947-2018 period.[14]

Figure 4 shows the implied profit rates from using the BBB rate and the equity rate. (The internal zero-profit rate, of course, implies a profit of zero at all times). In both cases, the profit rates are very high at the end of the sample—above 10 percent in the post-crisis period.

In the early post-war decades, however, the patterns are quite different. The equity real rate sys-

[14] The nominal ratio varies over time, but there is little apparent trend. Excluding land and inventories, the ratio averages a little below 2.

tematically implies negative profits until the mid-1990s. In contrast, the BBB rate implies very large pure profits until the late 1970s, then very large losses until the mid-1990s.

Hence, two plausible alternatives yield seemingly implausible estimates of profit rates. It seems unlikely that firms had large losses prior to the 1980s, as implied by the equity return. And it seems unlikely that firm profits were really as large in the 1950s as implied by the BBB rates.[15] Barkai (2018) and Karabarbounis and Neiman (2018) use a 10-year Treasury rate, which is uniformly lower than the BBB rate. These papers also omit land and inventories from the capital stock. Since the nominal value of land and inventories amounts to about 3/4 of GDP, they omit a sizeable category of capital payments. Using the 10-year Treasury rate, and omitting land and inventories, leads to a profits picture similar to their Figure 2. Notably, with a lower required rate and a smaller stock of capital, the apparent losses in the early 1980s are much smaller.

One approach with a long history in corporate finance is to use a weighted average cost of capital. Such an approach would average the required equity return and the required bond-market return—correspondingly, it would average the BBB and dividend-yield profit lines. Using a 30 percent weight on debt, and a 70 percent weight on equity (roughly the 1970s weights in corporate securities, according to Hall (2001)), the average pre-1979 profit rate is close to zero (about -3/4%). However, since both the equity and bond returns imply negative profits in the 1980s, the weighted average also implies substantial losses in that period. Similarly, the weighted average implies a sizeable positive profit rate, 10 percent or higher, in the mid-2000s and again in the post-2012 period.

The table below shows profit rates averaged over different samples. Using the BBB rate, the profit rate is positive for most samples shown. In contrast, for the dividend yield, the profit rate is negative for most samples shown—apart from the past few decades. The weighted average rate is close to zero (showing small losses) for most samples other than the post-2000 period.

4.2 How large is the markup?

Our estimated value of constant or near-constant returns to scale and the approximately 11 percent aggregate profit share, imply an aggregate markup of approximately 12 percent or less in the post-1990

[15] The BBB profits series is qualitatively similar to the results in Barkai (2018) and (the case-Π) in Karabarbounis and Neiman (2018).

period. Now using the three estimates of markups in the recent literature, along with the average profit rate of 11 percent, we back out what they imply about returns to scale. This exercise serves as a useful baseline for obtaining returns to scale without any actual estimation using the two-digit industry data. Column three in Table 6 presents the results. We find that markup estimate in De Loecker and Eeckhout (2017) implies relatively large increasing returns of 1.25. The estimate in Hall (2018) implies moderate increasing returns of 1.15, and the estimate in Traina (2018) gives approximately constant returns 1.02.

We now use our estimated value for the aggregate returns to scale and the three independent estimates of markups to back out the implied profit shares. These are shown in column 4 of Table 6. For the estimated markups in De Loecker and Eeckhout (2017), Hall (2018), and Traina (2018) we obtain profit rates of 28.5 percent, 23.1 percent, and 13 percent, respectively. The implied profit shares are moderate to substantially larger than estimated rate of 11 percent.

5 Conclusion

With the background of the much debated increase in market power in the U.S. since the late 1980s, we revisit an earlier literature on production-function based estimation using two-digit industry data and provide fresh estimates of aggregate returns to scale in the U.S. economy for the post-1990 period. The new estimates allow us to infer an implied markup and inform the ongoing debate.

We estimate constant or slightly decreasing returns to scale at the aggregate level in U.S. economy over 1989-2014 based on two datasets, namely 35KLEM and World KLEMS. The evidence based on World KLEMS data suggests that including the services sector tends to lower the estimate of returns to scale. In addition, the aggregation effects due to across-industry reallocation have weakened in this period and tend not to raise the estimates at the aggregate level as previously found in Basu and Fernald (1997). Our conclusion based on the industry level data is similar to Flynn, Gandhi and Traina (2019) who also find of constant returns to scale based on the Compustat data. Using an intuitive identity linking returns to scale, markups, and profit shares, we obtain an implied markup of approximately 12 percent, smaller than the estimates from the recent literature ranging from 15 to 40 percent. Put differently, given our estimated profit rate, large markups reported in the literature imply strongly increasing returns, which are not evident in the data. Under constant returns and large markups, the implied profit rates are substantially higher than the aggregate profit rate of 11 percent. Our findings suggest that approximately constant returns to scale in the aggregate economy are consistent with a relatively small aggregate markup in the post-1990 period.

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References

Barkai, S.: 2016, Declining labor and capital shares, *Stigler Center for the Study of the Economy and the State New Working Paper Series* **2**.

Barkai, S. and Benzell S G: 2018, 70 years of U.S. corporate profits, *Stigler Center for the Study of the Economy and the State New Working Paper Series* **22**.

Bartelsman, E. J., Caballero, R. J. and Lyons, R. K.: 1994, Customer-and supplier-driven externalities, *American Economic Review* **84**(4), 1075–1084.

Basu, S.: 2019, Are Price-cost Markups Rising in the United States? A Discussion of the Evidence, *NBER Working Paper 26057*.

Basu, S. and Fernald, J.: 1994, Constant returns and small markups in US manufacturing, *Technical report*, Board of Governors of the Federal Reserve System (US).

Basu, S. and Fernald, J. G.: 1995a, Aggregate productivity and the productivity of aggregates, *Technical report*, National Bureau of Economic Research.

Basu, S. and Fernald, J. G.: 1995b, Are apparent productive spillovers a figment of specification error?, *Technical report*, National Bureau of Economic Research.

Basu, S. and Fernald, J. G.: 1997, Returns to scale in US production: Estimates and implications, *Journal of Political Economy* **105**(2), 249–283.

Basu, S., Fernald, J. G. and Kimball, M. S.: 2006, Are technology improvements contractionary?, *American Economic Review* **96**(5), 1418–1448.

Brun, L. and González, I.: 2017, Tobin's q and inequality. *Manuscript*.

Burnside, C.: 1996, Production function regressions, returns to scale, and externalities, *Journal of Monetary Economics* **37**(2), 177–201.

Burnside, C., Eichenbaum, M. and Rebelo, S.: 1995, Capital utilization and returns to scale, *NBER Macroeconomics Annual* **10**, 67–110.

Caballero, R. J. and Lyons, R. K.: 1992, External effects in US procyclical productivity, *Journal of Monetary Economics* **29**(2), 209–225.

Chang, Y. and Hong, J. H.: 2006, Do technological improvements in the manufacturing sector raise or lower employment?, *American Economic Review* **96**(1), 352–368.

De Loecker, J. and Eeckhout, J.: 2017, The rise of market power and the macroeconomic implications, *Technical report*, National Bureau of Economic Research.

De Loecker, J., Eeckhout, J. and Unger G.: 2018, The rise of market power and the macroeconomic implications, *Technical report (revised)*, National Bureau of Economic Research.

De Loecker, J. and Eeckhout, J.: 2018, Global market power, *Technical report*, National Bureau of Economic Research.

De Loecker, J. and Eeckhout, J.: 2018, Some Thoughts on the Debate about (Aggregate) Markup Measurement, *Manuscript*.

Eggertsson, G. B., Robbins, J. A. and Wold, E. G.: 2018, Kaldor and Piketty's facts: The rise of monopoly power in the United States, *Technical report*, National Bureau of Economic Research.

Farhi, E. and Gourio, F.: 2018, Accounting for macro-finance trends: Market power, intangibles, and risk premia,*Technical report*, National Bureau of Economic Research.

Fernald, J.: 2014, Productivity and Potential Output Before, During, and After the Great Recession, *NBER Macroeconomics Annual, Volume 29*, University of Chicago Press, pp 1–51

Flynn, Z., Gandhi, A. and Traina, J.: 2019, Identifying market power from production data, *Manuscript*.

Gollop, F. M., Fraumeni, B. M. and Jorgenson, D. W.: 1987, Productivity and US economic growth.

Gutiérrez, G. and Philippon, T.: 2017, Declining competition and investment in the US, *Technical report*, National Bureau of Economic Research.

Hall, R. E.: 1988, The relation between price and marginal cost in US industry, *Journal of Political Economy* **96**(5), 921–947.

Hall, R. E.: 1990, Growth, productivity, unemployment: Essays to celebrate Bob Solow's birthday, MIT Press, Cambridge, MA, chapter Invariance properties of Solow's productivity residual.

Hall, R. E.: 2018, The stock market and capital accumulation, *American Economic Review*, **91**(5), 1185–1202.

Hall, R. E.: 2018, New evidence on the markup of prices over marginal costs and the role of mega-firms in the US economy, *Technical report*, National Bureau of Economic Research.

Hall, R. E., Blanchard, O. J. and Hubbard, R. G.: 1986, Market structure and macroeconomic fluctuations, *Brookings Papers on Economic Activity* **1986**(2), 285–338.

Jorgenson, D. W.: 1990, Productivity and economic growth, *in* E. Berndt and J. Triplett (eds), *Fifty Years of Economic Measurement: Studies in Income and Wealth*, Vol. 54, University of Chicago Press, Chicago, chapter 1, pp. 1–98.

Jorgenson, D. W.: 2008, *35 Sector KLEM*, Harvard Dataverse.

Jorgenson, D. W., Ho, M. S. and Samuels, J. D.: 2017, Educational attainment and the revival of us economic growth, *Education, Skills, and Technical Change: Implications for Future US GDP Growth*, University of Chicago Press.

Jorgenson, D. W. and Stiroh, K. J.: 2000, US economic growth at the industry level, *American Economic Review* **90**(2), 161–167.

Karabarbounis, L. and Neiman, B.: 2018, Accounting for factorless income, *Technical report*, National Bureau of Economic Research.

Rognlie, M.: 2016, Deciphering the fall and rise in the net capital share: accumulation or scarcity?, *Brookings Papers on Economic Activity* **2015**(1), 1–69.

Rotemberg, J. J, Woodford, M.:1995, Dynamic General Equilibrium Models with Imperfectly Competitive Product Markets, *in* T. Cooley (ed.), *Frontiers of Business Cycle Research*, Princeton University Press.

Ruzic, D. and Ho, S-J.: 2017, Returns to Scale, Productivity Measurement, and Trends in U.S. Manufacturing Misallocation,*Working Paper*, INSEAD.

Syverson, C.: 2019, Macroeconomics and market power: facts, potential explanations and open questions, *Brookings Economic Studies Report* **2019**

Traina, J.: 2018, Is aggregate market power increasing? production trends using financial statements, *Working Paper 17*, University of Chicago (Booth School of Business).

Table 1: **Aggregate estimates: US-KLEMS data**

	1989-2014		
γ	Private Economy	Manufacturing	Non-Manufacturing
Weighted Average	0.93	0.99	0.92
	(0.08)	(0.05)	(0.09)
Average	0.81*	0.92	0.75*
	(0.06)	(0.05)	(0.07)
Median	0.85*	0.91*	0.75*
	(0.06)	(0.04)	(0.00)
β	0.51	0.78	0.44
	(0.36)	(0.39)	(0.44)
Industries	50	33	17

NOTES: The table shows the IV system estimates of the Basu, Fernald and Kimball (2006) specification shown in (2) conducted in STATA using the `ivregress 2sls` command. The instruments are oil price increases, growth in real defense spending, and VAR monetary innovations. The robust standard errors in parenthesis are clustered at the industry level. The statistical significance is denoted by '$*$' indicating a p-value < 0.05 for $H_0 : \gamma = 1$ against $H_1 : \gamma < 1$. β is constrained to be equal within private economy and manufacturing, respectively, with the '$*$' indicating a p-value < 0.05 for $H_0 : \beta = 0$ against $H_1 : \beta \neq 0$.

Table 2: **Aggregate estimates: 35KLEM data**

	1989-2005		**1960-1988**	
γ	Private Economy	Manufacturing	Private Economy	Manufacturing
Weighted Average	0.89	1.03	0.94	0.96
	(0.09)	(0.05)	(0.09)	(0.05)
Average	0.86*	0.90*	0.94	0.90*
	(0.06)	(0.04)	(0.07)	(0.05)
Median	0.79*	0.85*	0.89*	0.87*
	(0.09)	(0.02)	(0.03)	(0.05)
β	0.83*	0.74*	1.63*	1.79*
	(0.16)	(0.15)	(0.23)	(0.35)
Industries	28	20	26	20

NOTES: The table shows the IV system estimates of the Basu, Fernald and Kimball (2006) specification shown in (2) conducted in STATA using the `ivregress 2sls` command. The instruments are oil price increases, growth in real defense spending, and VAR monetary innovations. The robust standard errors in parenthesis are clustered at the industry level. The statistical significance is denoted by '$*$' indicating a p-value < 0.05 for $H_0 : \gamma = 1$ against $H_1 : \gamma < 1$ and $H_1 : \gamma > 1$ for estimates greater than 1. β is constrained to be equal within private economy and manufacturing, respectively, and the statistical significance is denoted by '$*$' indicating a p-value < 0.05 for $H_0 : \beta = 0$ against $H_1 : \beta \neq 0$.

Table 3: **Parameter estimates: 35-KLEM, full-sample (1960-2005)**

Durable manufacturing		Nondurable manufacturing		Non-manufacturing	
A. Returns-to-scale (γ_i) estimates					
Lumber and wood products	0.57	Food and kindred products	0.83	Construction	0.97
	(0.05)		(0.05)		(0.06)
Furniture and fixtures	0.93	Tobacco	0.99	Transportation	1.08
	(0.08)		(0.00)		(0.17)
Stone, clay and glass	1.13	Textile mill products	0.58	Communications	0.68
	(0.06)		(0.10)		(0.04)
Primary metals	0.97	Apparel	0.81	Trade	0.80
	(0.06)		(0.01)		(0.20)
Fabricated metal products	1.19	Paper and allied	1.06	FIRE	0.26
	(0.05)		(0.03)		(0.09)
Non-electrical machinery	1.21	Printing and publishing	1.47	Services	1.06
	(0.02)		(0.16)		(0.07)
Electrical machinery	1.24	Chemicals	1.64		
	(0.01)		(0.07)		
Motor vehicles	0.96	Petroleum and coal	0.40		
	(0.05)		(0.17)		
Transportation equipment	(0.45)	Rubber and plastic	0.93		
	(0.01)		(0.08)		
Instruments	0.80	Leather	0.17		
	(0.05)		(0.06)		
Misc. manufacturing	1.00				
	(0.03)				
Column average	0.98		0.92		0.81
Median	0.98		0.93		0.88
Weighted average	1.00		1.11		0.79
Private Economy Average	0.89	Median	0.96	Weighted average	0.87
B. Coefficient on hours per worker					
Durables	0.69	Nondurables	1.73	Nonmanufacturing	1.00
manufacturing	(0.34)	manufacturing	(0.57)		(1.59)

NOTES: The table shows the IV system estimates of the Basu, Fernald and Kimball (2006) specification shown in (2) based on second stage regression. The predicted values of cost-weighted growth rates in inputs dx and growth rate of hours-per-worker dh are estimated in the first stage regression. The instruments are oil price increases, growth in real defense spending, and VAR monetary innovations. The robust standard errors in parenthesis are clustered at the industry level. Constant terms are not shown. β is constrained to be equal within durables, nondurables and non-manufacturing sectors, respectively. FIRE is finance, insurance, and real estate. Electric and Gas utilities are excluded due to negative estimates of γ_i.

Table 4: **Interaction (slope) dummy estimates: 35-KLEM data (1989-2005)**

Durable manufacturing		Nondurable manufacturing		Nonmanufacturing	
A. $D \times \triangle x$					
Lumber and wood	-0.20	Food and kindred	-0.38***	Construction	-0.31***
Furniture and fixtures	-0.08	Tobacco	-0.08***	Transportation	-0.57***
Stone, clay and glass	-0.43**	Textile mill	0.20	Communications	-0.40***
Primary metals	-0.15	Apparel	2.86***	Trade	-0.32***
Fabricated metal	-0.52***	Paper and allied	-1.48***	FIRE	-0.25***
Non-electrical machinery	-0.14***	Printing & publishing	-1.67***	Services	-0.07***
Electrical machinery	0.38***	Chemicals	-1.25		
Motor vehicles	-0.17	Rubber and plastic	-0.55		
Transportation equipment	0.26***				
Misc. manufacturing	-0.28**				
B. $D \times \triangle h$					
Durables	-1.91	Nondurables	-2.22***	Nonmanufacturing	1.94

NOTES: The table shows the IV system estimates of interaction (slope) dummy in the Basu, Fernald and Kimball (2006) specification shown in (6) based on second stage regression. The predicted values of cost-weighted growth rates in inputs dx and growth rate of hours-per-worker dh are estimated in the first stage regression. The instruments are oil price increases, growth in real defense spending, and VAR monetary innovations. The robust standard errors in parenthesis are clustered at the industry level. not shown. The statistical significance is denoted by '*' indicating a p-value < 0.05 for the null hypothesis that dummy slope is zero against alternative that dummy slope is not equal to zero.

Table 5: **Profit rates under different assumptions about real returns**

	BBB (bond)	Dividend yield (equity)	Weighted avg.	10 year (bond)
Full sample	5.4	-2.9	-0.4	12.0
1960-2005	-0.4	-4.9	-3.5	6.2
1947-1979	14.6	-7.3	-0.8	18.7
1947-2014	4.9	-3.7	-1.1	11.4
1989-2014	1.7	5.8	4.6	10.8
2000-2018	8.8	11.7	10.9	18.9

NOTES: Entries are percent of business-sector output, averaged over different sample periods. The real rates on BBB bonds and 10-year Treasury securities is the nominal rate less a smooth moving average of log changes in the business-sector deflator. The dividend yield rate is the dividend yield on the S&P 500 plus a smoothed trend in real GDP growth (estimated with a biweight filter with a parameter of 48 quarters). The weighted average uses a weight of 30 percent on the BBB rate and 70 percent on the dividend yield.

Table 6: **Implications for the aggregate markup and the profit share**

(1)	(2)	(3)	(4)
	Estimated Markup (μ)	Implied Returns to Scale (γ) (Estimated: $S_\pi = 10.9\%$)	Implied Profit Share (S_π) (Estimated: $\hat{\gamma} \approx 1$)
De Loecker and Eeckhout (2017)	40%	1.25	28.5%
Hall (2018)	30%	1.15	23.1%
Traina (2018)	15%	1.02	13%
This paper (implied markup)	12%		

NOTES: The numbers in columns 3 to 4 are obtained using equation (1). S_π = 10.9 is from Table 5.

Figure 1: **Estimates of Returns-to-Scale: US-KLEMS data (1989-2014)**

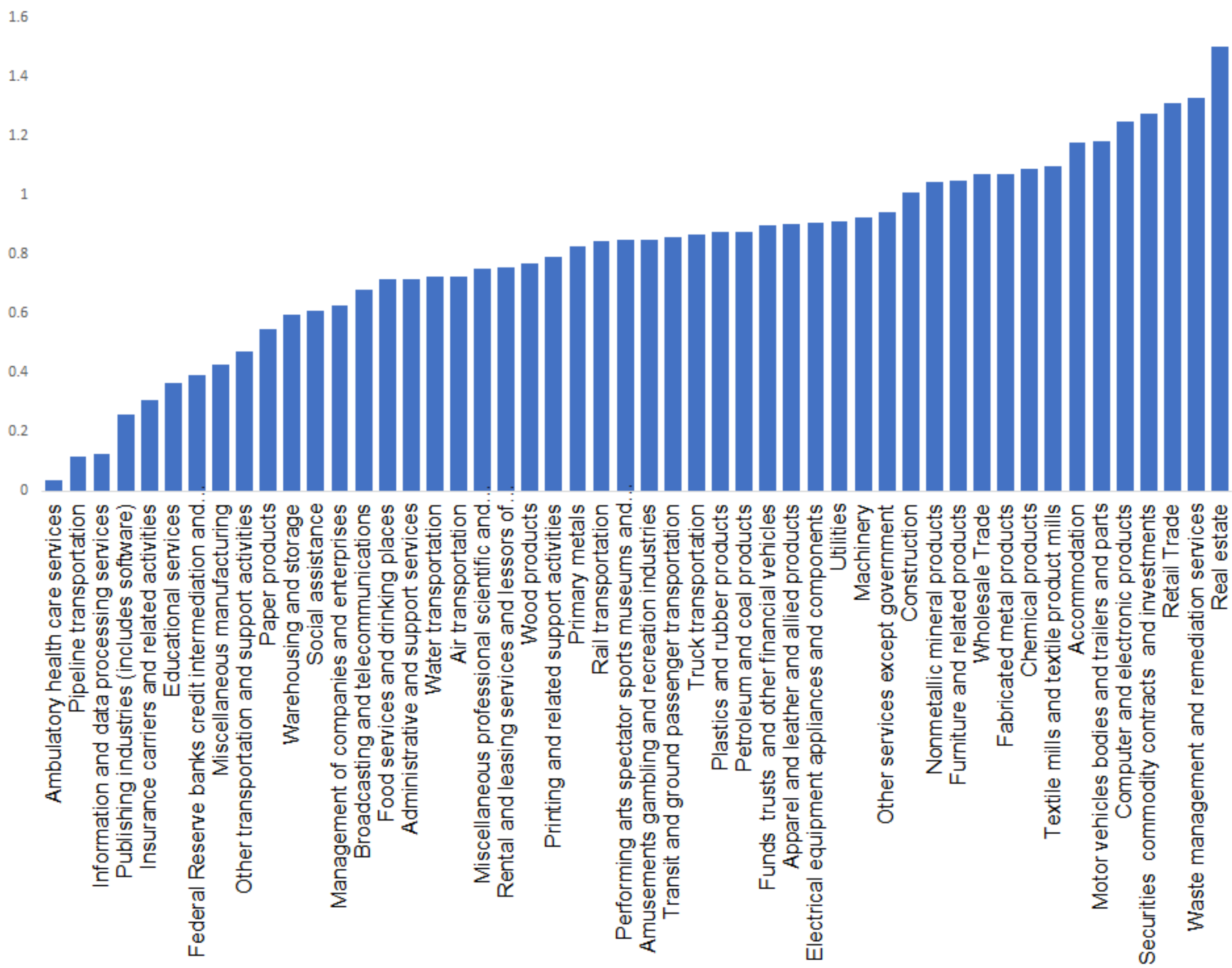


Figure 2: **Estimates of Returns-to-Scale: 35KLEM data (1989-2005)**

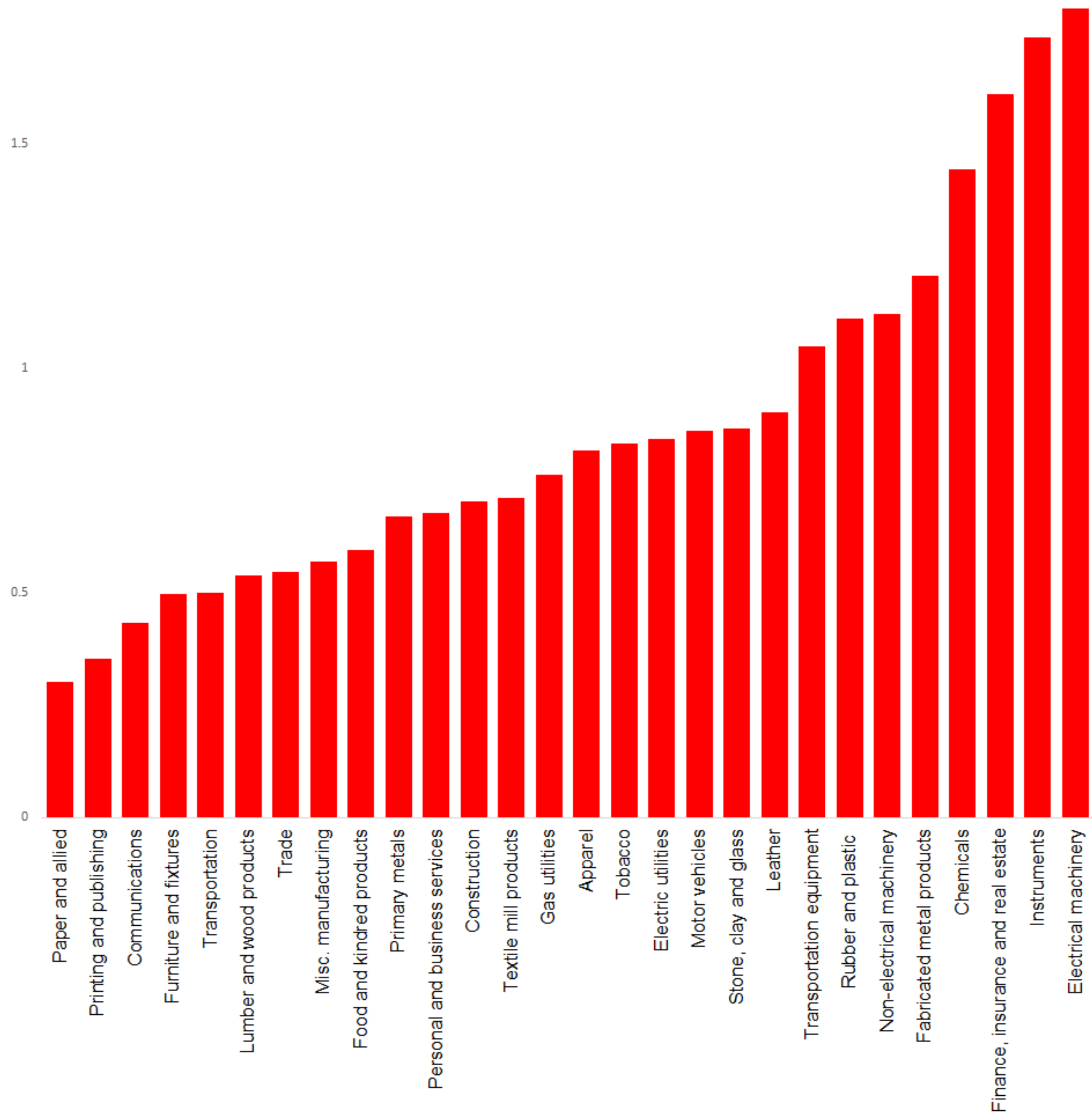


Figure 3: **Real Rates of Returns**

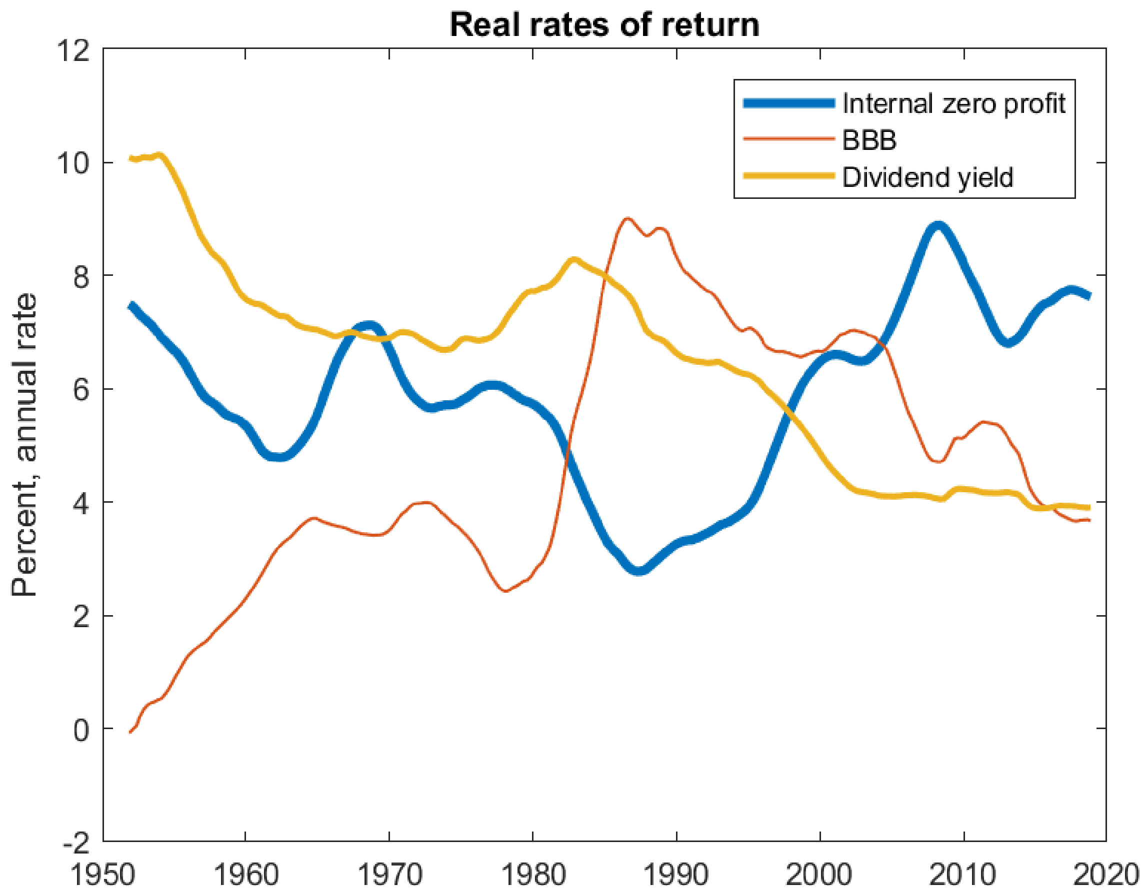
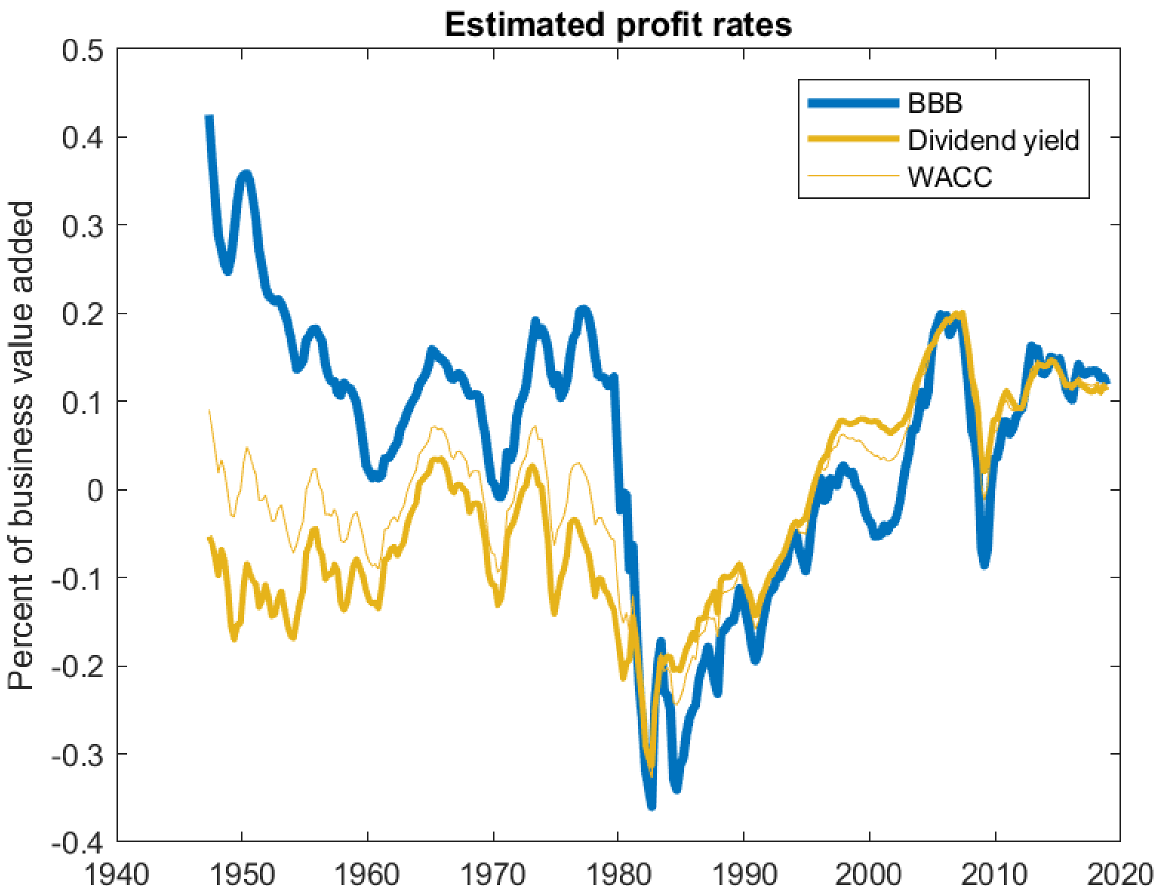


Figure 4: **Profit Rates Under Different Assumptions About Real Returns**



1 Online Appendix

1.1 Theory

This section revisits the framework developed by Hall, Blanchard and Hubbard (1986), Hall (1988), Hall (1990) and Basu and Fernald (1994) to estimate returns to scale and uncover average markups in the US manufacturing sector for a given profit share. We assumed the following specification of an industry's production function:

$$Y_{it} = F(K_{it}, L_{it}, M_{it}, T_{it}) \tag{10}$$

Where Y_{it} is gross output of industry i at time t, K_{it} is capital serviced used by industry i at time t, L_{it} is labor services used by industry i at time t, M_{it} is material used by industry i at time t, and T_{it} is level of technology in industry i at time t. If function F is differentiable and homogeneous of degree γ in (K, L, M) and homogeneous of degree one in T_{it} then growth in gross output of industry i takes the following form:

$$\Delta y_{it} = F_{Kit}\frac{K_{it}}{Y_{it}}\Delta k_{it} + F_{Lit}\frac{L_{it}}{Y_{it}}\Delta l_{it} + F_{Mit}\frac{M_{it}}{Y_{it}}\Delta m_{it} + \Delta\epsilon_{it} \tag{11}$$

$$\Rightarrow \qquad \Delta y_{it} = \eta_{YK}\Delta k_{it} + \eta_{YL}\Delta l_{it} + \eta_{YM}\Delta m_{it} + \Delta\epsilon_{it} \tag{12}$$

where lower-case letters are logs of the variables defined above, F_J is the derivative of production technology with respect input J and η_{YJ} is the elasticity of output with respect to input J where $J = K, L$ and M and $\Delta\epsilon_{it}$ is the growth rate in technology. The sum of output elasticities with respect to input J equals the degree of returns to scale γ, hence

$$\gamma_i = \eta_{YK} + \eta_{YL} + \eta_{YM} \tag{13}$$

With assumption that input markets are competitive and firms have some degree of market power in the goods market. The cost-minimization with respect input J implies that

$$W_{Jt} = mc_{Jit}F_{Jit} \tag{14}$$

where W_{Jit} is the cost of input J in industry i and mc_{Jit} is the marginal cost of input input J in industry i. Equation (14) can be rewritten as

$$\frac{W_{Jt}J_{it}}{P_{it}Y_{it}} = \frac{mc_{it}F_{Jit}J_{it}}{P_{it}Y_{it}} \tag{15}$$

$$\Rightarrow \qquad S_{Jit} = \frac{F_{Jit}J_{it}}{\mu_i Y_{it}} \tag{16}$$

$$\Rightarrow \qquad \mu_i S_{Jit} = \frac{F_{Jit}J_{it}}{Y_{it}} = \eta_{YJ} \tag{17}$$

where μ is defined as markup of output price over marginal cost, η_{YJ} is the elasticity of output with respect to input J and S_J is the share of input J in total revenue. Hence, equation (17) implies that elasticity of output with respect to input J is equals to a markup μ multiplied by the share of that input J in total revenue, S_J. Under perfect competition $P = mc$ or $\mu = 1$ then equation (17) implies that elasticity of output with respect to input J is equal to the input's share in total revenue. Moreover, the first order conditions and equation (17) under imperfect competition can be expressed as follows:

$$F_{Kit}\frac{K_{it}}{Y_{it}} + F_{Lit}\frac{L_{it}}{Y_{it}} + F_{Mit}\frac{M_{it}}{Y_{it}} = \mu_i\Big(S_{Kit} + S_{Lit} + S_{Mit}\Big) \tag{18}$$

$$\Rightarrow \qquad \eta_{YK} + \eta_{YL} + \eta_{YM} = \mu_i\Big(1 - S_{\pi_{it}}\Big) \tag{19}$$

$$\Rightarrow \qquad \gamma_i = \mu_i\Big(1 - S_{\pi_{it}}\Big) \tag{20}$$

which is the relationship shown in (1).

Equation (18) also implies that

$$\gamma_i = \frac{\mu_i\Big(W_{Kt}K_{it} + W_{Lt}L_{it} + W_{Mt}M_{it}\Big)}{P_{it}Y_{it}} \tag{21}$$

$$\Rightarrow \qquad \gamma_i = \frac{\mu_i\Big(TC_{it}\Big)}{P_{it}Y_{it}} \tag{22}$$

$$\Rightarrow \qquad \frac{\gamma_i\Big(W_{Jt}J_{it}\Big)}{TC_{it}} = \frac{\mu_i\Big(W_{Jt}J_{it}\Big)}{P_{it}Y_{it}} \tag{23}$$

$$\Rightarrow \qquad \gamma_i C_{Jit} = \mu_i S_{Jit} \tag{24}$$

$$\Rightarrow \qquad \gamma_i C_{Jit} = \mu_i S_{Jit} = \eta_{YJ} \tag{25}$$

substituting (25) in (12) gives

$$\Delta y_{it} = \gamma_i\Big(C_{Kit}\Delta k_{it} + C_{Lit}\Delta l_{it} + C_{Mit}\Delta m_{it}\Big) + \epsilon_{it} \tag{26}$$

$$\Rightarrow \qquad \Delta y_{it} = \gamma_i \Delta x_{it} + \epsilon_{it} \tag{27}$$

where Δx_{it} is a cost-weighted sum of growth rates in inputs. Most of the studies related to returns to scale estimate equation (27), which is also known as production function based regression equation (Basu and Fernald 1995a, Burnside 1996, Hall 1988, 1990, Hall et al. 1986,?). Basu and Fernald (1994) estimated equation (27) and used (20) to back out an average aggregate markup estimate, given the aggregate profit share.

Table A1: Industry Classification: World KLEMS

Industry Description	NAICS 3 digit
A. Manufacturing	
Food and Beverage and Tobacco Products (N)	311,312
Textile Mills and Textile Product Mills (N)	313,314
Apparel and Leather and Applied Products (N)	315,316
Paper Products (N)	322
Printing and Related Support Activities (N)	323
Petroleum and Coal Products (N)	324
Chemical Products (N)	325
Plastics and Rubber Products (N)	326
Wood Products (D)	321
Nonmetallic Mineral Products (D)	327
Primary Metal Products (D)	331
Fabricated Metal Products (D)	332
Machinery (D)	333
Computer and Electronic Products (D)	334
Electrical Equipment, Appliances, and Components (D)	335
Motor vehicles bodies and trailers and parts (D)	336MV
Other transportation equipment (D)	336OT
Furniture and Related Products (D)	337
Miscellaneous Manufacturing (D)	339
B. Non-manufacturing	
Farms	111,112
Forestry, Fishing, and Related Activities	113-115
Oil and Gas Extraction	211
Mining, except Oil and Gas	212
Support Activities for Mining	213
Utilities	220
Construction	230
Wholesale Trade	42
Retail Trade	44,45
Air Transportation	481

Continued on next page

Table A1 – *Continued from previous page*

Industry Description	**NAICS 3 digit**
Rail Transportation	482
Water Transportation	483
Truck Transportation	484
Transit and Ground Passenger Transportation	485
Pipeline Transportation	486
Other Transportation and Support Activities	487,488,492
Warehousing and Storage	493
Publishing industries, except internet [includes software]	511
Motion picture and sound recording industries	512
Broadcasting and telecommunications	515,517
Data processing, internet publishing, and other information services	518,519
Federal Reserve Banks, Credit Intermediation, and Related Activities	521,522
Securities, Commodity Contracts, and Investments	523
Insurance Carriers and Related Activities	524
Funds, Trusts, and Other Financial Vehicles	525
Real Estate	531
Rental and Leasing Services and Lessors of Intangible Assets 3/	532,533
Legal Services	5411
Computer Systems Design and Related Services	5415
Miscellaneous Professional, Scientific, and Technical Services 2/ 3/	5412-5414, 5416-5419
Management of Companies and Enterprises	55
Administrative and Support Services	561
Waste Management and Remediation Services	562
Educational Services	61
Ambulatory Health Care Services	621
Hospitals and Nursing and Residential Care Facilities	622, 623
Social Assistance	624
Performing Arts, Spectator Sports, Museums, and Related Activities	711,712
Amusements, Gambling, and Recreation Industries	713
Accommodation	721
Food Services and Drinking Places	722
Other Services, except Government	81

Table A2: Industry Classification: 35 - KLEMS

Non-manufacturing	Approx. SIC	Non-durable	Approx. SIC	Durable	Approx. SIC
Agriculture	01-09	Food and kindred products	20	Lumber and wood	24
Metal mining	10	Tobacco	21	Furniture and fixtures	25
Coal mining	11-12	Textile mill products	22	Stone, clay, glass	32
Oil and gas extraction	13	Apparel	23	Primary metal	33
Non-metallic mining	14	Paper and allied	26	Fabricated metal	34
Construction	15-17	Printing, publishing and allied	27	Machinery, non-electical	35
Transportation	40-47	Chemicals	28	Electrical machinery	36
Communications	48	Petroleum and coal products	29	Motor vehicles	371
Electric utilities	491	Rubber and misc plastics	30	Transportation equipment & ordnance	372-79
Gas utilities	492	Leather	31	Instruments	38
Trade	50-59			Misc. manufacturing	39
Services	(various)				