Declining Labor and Capital Shares

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Abstract

This paper shows that the decline in the labor share over the past 30 years was not offset by an increase in the capital share. Capital costs are the product of the required rate of return on capital and the value of the capital stock, and the capital share is the ratio of capital costs to gross value added. The capital share is declining, driven by a large decline in the cost of capital. Measured in percentage terms, the decline in the capital share (25%) is much more dramatic than the decline in the labor share (10%). The pure profit share has increased by more than 14 percentage points. The value of this increase in pure profits amounts to over $1.2 trillion in 2014, or $15 thousand per employee. The decline in the capital share is unlikely to be driven by unobserved capital. In a standard model, a decline in competition is necessary to generate simultaneous declines in the labor and capital shares. A calibrated model shows that a decline in competition quantitatively matches the data. This paper provides reduced form empirical evidence that a decline in competition plays a significant role in the decline in the labor share. Increases in industry concentration are associated with declines in the labor share. These results suggest that the decline in the shares of labor and capital are due to a decline in competition and call into question the conclusion that the decline in the labor share is an efficient outcome.

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1 Introduction

Since the early 1980s we have witnessed a large decline in the labor share of gross value added (Elsby, Hobijn and Şahin (2013); Karabarbounis and Neiman (2014)). Many existing explanations for the decline in the labor share, such as technological change, mechanization, capital accumulation, and a change in the relative price of capital, focus on tradeoffs between labor and physical capital. These explanations argue that firms have substituted expenditures on labor inputs into production with expenditures on physical capital inputs into production and each of these explanations offers a different rationale for this substitution. Furthermore, these explanations view the shift from labor inputs to capital inputs as an efficient outcome. In this paper, I show that the shares of both labor and capital are declining and are jointly offset by a large increase in the share of pure profits.

In this paper, I draw a distinction between capital costs and pure profits and show that this distinction is critical for understanding the decline in the labor share. *Capital costs* are the annual costs of using all capital inputs in production. In a world in which firms lease all of their capital inputs, constructing capital costs would be simple: we would sum all annual leasing expenses. *Pure profits* are what a firm earns in excess of all production costs (material inputs, labor costs, and capital costs). Firms that use a lot of expensive equipment have high capital costs. Firms that charge consumers high prices relative to the cost of production have high pure profits. An increase in the capital share, equal to the ratio of capital costs to gross value added, at the expense of the labor share is indicative of a substitution from labor to capital inputs into production. By contrast, an increase in the pure profit share, equal to the ratio of pure profits to gross value added, is indicative of an increase in market power and a decline in competition.

Measuring capital costs presents an empirical challenge. Most of the physical capital stock is owned by firms rather than leased. When firms own physical capital, they do not report an annual line item that approximates annual leasing costs and these costs cannot be backed out from accounting measures of profits. Moreover, there are forms of productive capital that are not physical, such as software, R&D, and product designs. These forms of intangible capital are at times firm-specific and therefore cannot easily be leased. To overcome these challenges, for each type of capital I compute a *required rate of return*, which approximates the annual leasing cost of one dollar's worth of this type of capital. This approach is grounded in economic theory, supported by past research, and is similar to approximating a wage bill for an unincorporated business. Given a required rate of return, it is straightforward to aggregate across the various types of capital to come up with an aggregate measure of capital costs.

Following Hall and Jorgenson (1967), I compute a series of capital costs for the U.S. non-financial corporate sector over the period 1984–2014, equal to the product of the required rate of return on capital and

the value of the capital stock. The required rate of return is a function of the cost of borrowing in financial markets (henceforth, *cost of capital*), depreciation rates, expected price inflation of capital, and the tax treatment of both capital and debt. In simplified models, this required rate of return is the familiar $r + \delta$. Over this time period, all measures of the cost of capital show a large decline of at least 46%. At the same time, measures of expected and realized inflation show no trend. The required rate of return on capital declines sharply, due to the large decline in the cost of capital.

The large decline in the required rate of return does not necessarily imply a decline in the capital share. In a typical model of firm production, firms respond to the decline in the required rate of return by increasing their use of capital inputs. If firms respond strongly enough, the increase in capital inputs is larger than the decline in the required rate of return and as a result the capital share increases. Indeed, this is the common prediction of all the explanations for the decline in the labor share that focus on tradeoffs between labor and physical capital.

However, the U.S. non-financial corporate sector does not sufficiently increase its use of capital inputs to offset the decline in the required rate of return and as a result the capital share declines. The decline in the risk-free rate and the lack of capital accumulation have been noted by Furman and Orszag (2015). Measured in percentage terms, the decline in the capital share (25%) is much more dramatic than the decline in the labor share (10%). Back in 1984, every dollar of labor costs was accompanied by approximately 49¢ of capital costs. By 2014, a dollar of labor costs was accompanied by only 41¢ of costs. Thus, despite the decline in the labor share, labor costs have increased faster than capital costs.

As a share of gross value added, since the early 1980s firms have reduced both labor and capital costs and increased pure profits. Consistent with earlier research, I find that pure profits were very small in the early 1980s. However, pure profits have increased dramatically since the early 1980s. In the main specification, the pure profit share (equal to the ratio of pure profits to gross value added) increases by 14 percentage points. To offer a sense of the magnitude, the value of this increase in pure profits amounts to over $1.2 trillion in 2014, or $15 thousand for each of the approximately 81 million employees of the non-financial corporate sector. Across all of the specifications that I consider, the pure profit share has increased by more than 12 percentage points, which amounts to over $1.1 trillion in 2014, or $14 thousand per employee.

One concern with the measurement of capital costs and pure profits is the possibility of omitted or unobserved capital. Past research has considered several forms of intangible capital that are not currently capitalized by the BEA and has argued that these are important for explaining asset valuations and cash flows. The inclusion of additional capital likely increases the capital share and decreases the pure profit share. At the same time, the effects of including additional capital on the time trends of the capital and pure profit shares are less clear. The large decline in the cost of capital equally affects the required rate

of return on any additional form of capital. As a result, if this additional capital grows only at the rate of output then the additional capital costs will grow far slower than output. Thus, in order for this additional capital to have a mitigating effect on the measured trends of the shares of capital and pure profits, the stock of additional capital would need to grow significantly faster than output.

I take two approaches to assessing the contribution of omitted intangible capital to the measured increase in pure profits. First, I incorporate the most comprehensive existing measures of omitted intangible capital into the analysis. Second, I construct a large number of scenarios for omitted intangible capital. Each scenario is a parameterization of investment, depreciation, and capital inflation of intangible capital. For each scenario, I compute capital costs and pure profits that fully incorporate the unobserved investment. I find that existing measures of intangible capital are unable to explain the rise in pure profits. Of the large number of scenarios that I consider, none can fully account for the rise in pure profits. There are scenarios that can account for most of the increase in pure profits, but in all such scenarios the value of missing intangible capital in 2014 would need to be larger than all capital measured by the BEA (structures, equipment, intellectual property products).

An increase in the importance of omitted intangible capital and a rise in pure profits are not mutually exclusive. Of the many scenarios of omitted intangible capital that I consider, many feature a simultaneous increase in intangible capital as well as a large increase in pure profits. In this sense, the measured rise in pure profits is consistent with many scenarios that feature rapidly increasing intangible capital.

I present an alternative measure of capital costs and pure profits that are derived from aggregate market valuations. High market valuations relative to the nominal value of capital imply high pure profits. The implementation of this approach only requires data on market values of debt and equity and the nominal value of the capital stock. This approach does not rely on any assumptions of the required rate of return on capital or its components. I find that the market-valuation implied pure profit share is similar in trend and level to the flow measures of the pure profit share that are constructed by assuming a required rate of return on capital.

Turning to possible explanations for the simultaneous declines in the labor and capital shares, I present a standard general equilibrium model with imperfect competition. The model points to a decline in competition and an increase in markups as the explanation for the declines in the labor and capital shares. The growing gap between labor productivity and wages as well as the lack of capital accumulation in response to the decline in the required rate of return are features of declining competition. The degree of generality of the model allows us to consider a wide range of alternative explanations for the decline in the labor share, including a slowdown in TFP growth, capital-biased technological change, a change in relative prices, and a change in the supply of labor. Under appropriate assumptions, each of these alternative explanations can

cause a decline in the labor share. However, common to all of these explanations is the fact that any such decline in the labor share has to be entirely offset by an increase in the capital share. Only a decline in competition can explain a simultaneous decline in the shares of labor and capital. In this sense, a decline in competition is necessary to match the data.

Using the model, I perform two sets of counterfactual exercises. The first set of counterfactual exercises are backward-looking: they ask how the labor share, capital share, and investment rate should have evolved from 1984 to 2014 in response to the decline in competition that is inferred from the data. The second set of model-based counterfactual estimates are forward-looking: they ask how output, wages, and investment can be expected to evolve from 2014 onward if competition were increased to its 1984 level. Looking backward, the model predicts declines in the labor and capital shares over the period 1984–2014 in response to the decline in competition that quantitatively match the observed declines. Looking forward, the model implies that an increase in competition will increase output (9%), wages (23%), and investment (16%).

Last, I provide reduced-form empirical evidence that a decline in competition and an increase in markups have played a significant role in the decline in the labor share. I show that those industries that experience a larger increase in concentration also experience a larger decline in the labor share. Based on the estimated correlations and the observed increase in industry concentration, the predicted decline in the labor share is of the same magnitude as the observed decline in the labor share. In this sense, the increase in industry concentration can account for most of the decline in the labor share. These results complement the aggregate findings, as (1) they rely on cross-sectional rather than time-series variation and (2) they do not rely on capital data and therefore are not subject to concerns about the measurement of capital. Taken as a whole, my results suggest that the decline in the shares of labor and capital are due to a decline in competition and they call into question the conclusion that the decline in the labor share is an efficient outcome.

2 Literature Review

There have been many recent empirical and theoretical contributions to the study of the decline in the labor share. Elsby, Hobijn and Şahin (2013) provide detailed documentation of the decline in the U.S. labor share and Karabarbounis and Neiman (2014) document a global decline in the labor share. Many possible explanations for the decline in the labor share have been put forward, including capital-augmenting technological change and the mechanization of production (Zeira (1998); Acemoglu (2003); Summers (2013); Brynjolfsson and McAfee (2014); Acemoglu and Restrepo (2016)), a decline in the relative price of capital (Jones (2003); Karabarbounis and Neiman (2014)), capital accumulation (Piketty (2014); Piketty and Zucman (2014)), globalization (Elsby, Hobijn and Şahin (2013)), a decline in the bargaining power of labor (Blanchard and

Giavazzi (2003); Bental and Demougin (2010); Stiglitz (2012)), and an increase in the cost of housing (Rognlie (2015)). I contribute to this literature by documenting and studying the simultaneous declines in the shares of labor and capital and by emphasizing the role of declining competition and increasing markups.

Previous studies have considered the welfare implications of the decline in the labor share. Fernald and Jones (2014), drawing on Zeira (1998), show that a decline in the labor share that is due to the mechanization of production leads to rising growth and income. Karabarbounis and Neiman (2014) find that the decline in the labor share is due in part to technological progress that reduces the relative cost of capital, which leads to a substantial increase in consumer welfare, and in part to an increase in markups, which reduces welfare. The authors find that the increase in welfare due to the change in the relative price of capital is far greater than the decline that is due to the change in markups. Acemoglu and Restrepo (2016) present a model in which the labor share fluctuates in response to capital-augmenting technological change and show that the endogenous process of technology adoption, in the long run, restores the labor share to its previous level. Blanchard and Giavazzi (2003) present a model in which a decline in the bargaining power of labor leads to a temporary decline in the labor share and a long-run increase in welfare. By contrast, I find that the decline in the labor share is due to a decline in competition and an increase in markups, is accompanied by large gaps in output, wages, and investment, and that without a subsequent increase in competition, the labor share will not revert to its previous level.

The measurement of the capital share in this paper builds on the work of Karabarbounis and Neiman (2014) and Rognlie (2015). Karabarbounis and Neiman (2014) and Rognlie (2015) study the decline in the labor share and additionally provide an estimate of the capital share. Both papers find that the capital share does not sufficiently increase to offset the decline in the labor share and furthermore the capital share might decrease slightly.[1] Both papers use quantity–based measures to estimate the decline in the capital share: Karabarbounis and Neiman (2014) measure the percentage change in the capital share as the percentage change in the ratio of investment to gross value added, while Rognlie (2015) measures the percentage change in the capital share as the percentage change in the ratio of the value of the capital stock to gross value added. Unlike these papers, I use market prices to measure debt and equity costs of capital. The cost of capital halves over the period 1984–2014, which leads to a large decline in the required rate of return. The capital stock does not grow fast enough to offset the large decline in the required rate of return and as a result the capital share declines. Measures of the capital share that assume a constant required rate of return show no decline; measures of the capital share that incorporate market prices show a large decline. See Section 3.7.1 for further details.

The model that I use to study the decline in the shares of labor and capital is standard and essentially

[1] See Karabarbounis and Neiman (2014) Section IV.B and column 6 of Table 4; Rognlie (2015) Section II.B.

identical to the model that appears in Karabarbounis and Neiman (2014). The use of a standard model ensures that the model-based results are not due to novel modeling features, but rather are a direct consequence of the measurement of the capital share. Based on their measurement of the capital share (no decline), the model in Karabarbounis and Neiman (2014) attributes half of the decline in the labor share to an increase in markups and half of the decline to a decline in the relative price of capital. Furthermore, Karabarbounis and Neiman (2014) find that, on net, the decline in the labor share has been accompanied by large welfare gains. Based on my measurement of the capital share (large decline), the model in Section 4 attributes all of the decline in the labor share to a decline in competition and an increase in markups and further finds that the decline in the labor share has been accompanied by large gaps in output, wages, and investment. See Section 4.4 for further details.

This paper contributes to a large literature on the macroeconomic importance of competition and markups. Rotemberg and Woodford (1995) provide evidence suggesting that the share of pure profits in value added was close to zero in the period prior to 1987. Basu and Fernald (1997) find that U.S. industries had a pure profit share of sales of at most 3 percent during the period 1959-1989. Theoretic research has argued that in a setting without pure profits, there are benefits to ex-post measurements of capital costs (realized value added less realized labor costs) instead of ex-ante capital costs (the product of the required rate of return on capital and the value of the capital stock).[2] Past empirical estimates of small economic pure profits together with the potential theoretical advantage of indirectly inferring capital costs have led many researchers to prefer the assumption of zero pure profits over the direct measurement of capital costs. Indeed, the seminal works of Jorgenson, Gollop and Fraumeni (1987) and Jorgenson and Stiroh (2000) that measure changes in U.S. productivity do not estimate capital costs,[3] and many subsequent studies follow in their path. By contrast, my findings overturn previous empirical measurements of pure profits. While I confirm previous estimates of low pure profits in the early 1980s, I show that pure profits have substantially increased since the early 1980s. Moreover, I show that the decline in competition that generates these pure profits are potentially large enough to generate large declines in the shares of labor and capital, as well as a large gaps in output, wages, and investment.

Last, this paper contributes to a recent and diverse literature on declining competition. Peltzman (2014) shows that concentration, which (on average) had been unchanged from 1963 to 1982, began rising after the Department of Justice Merger Guidelines adopted Robert Bork's "Rule of Reason." Recent studies of mergers and acquisitions (M&A) in manufacturing industries find evidence that consolidation has led to a decline in competition and consumer surplus. Kulick (2016) studies M&As in the quick-mix concrete

[2]Hulten (1986) and Berndt and Fuss (1986) show that in settings without pure profits, ex-post measures of capital costs can properly account for cyclical patterns in capital utilization.

[3]See for example Jorgenson, Ho and Stiroh (2005), p. 157.

industry and shows that horizontal mergers are associated with an increase in price and a decline in output, leading to a substantial decline in consumer surplus. Blonigen and Pierce (2016) study the effect of M&As in manufacturing industries and find that M&As are associated with increases in markups, but have little or no effect on productivity or efficiency.

Increases in pure profits are reflected in measures of corporate valuations and profitability. Lindenberg and Ross (1981) and Salinger (1984) provide theoretical and empirical support that relates Tobin's q, the ratio of the market value of a firm to the replacement value of assets, to market power and pure profits. Recent studies find evidence that increases in concentration and barriers to entry increase the market value of incumbent firms. Grullon, Larkin and Michaely (2016) show that the large increase in industry concentration has been driven by the consolidation of publicly traded firms into larger entities and that firms in industries with the largest increases in product market concentration have enjoyed higher profit margins, positive abnormal stock returns, and more profitable M&A deals. Bessen (2016) provides evidence that increases in federal regulation favor incumbent firms and lead to increases in market valuations and operating margins. Bessen concludes that increases in federal regulation and political rent seeking have increased corporate valuations by $2 trillion and annually transfer $200 billion from consumers to firms. Gonzalez and Trivın (2016) show in a panel of 41 countries that an increase in Tobin's q is associated with a decline in the labor share.

In addition to the increase in industry concentration, concentration of firm ownership is on the rise. Azar (2012) documents a large increase in the concentration of ownership. Fichtner, Heemskerk and Garcia-Bernardo (2017) find that, together, BlackRock, Vanguard, and State Street constitute the largest shareholder in 88 percent of S&P 500 firms. Recent work has linked the increase in common ownership to a decline in competition. Azar, Schmalz and Tecu (2016) show that increases in common ownership of airlines have increased prices by as much as 10%. Azar, Raina and Schmalz (2016) show that the increase in the concentration of bank ownership has led to higher fees, thresholds, and lower returns on savings.

This paper contributes to the literature on declining competition in three ways. First, this paper provides an aggregate measure of pure profits. To the best of my knowledge no such measure exits for the past three decades. Second, this paper highlights the macroeconomic implications of declining competition and increasing markups. Using a calibrated model, I find that a decline in competition quantitatively matches the decline in the labor share. Furthermore, an increase in competition to its 1984 level would lead to large increases in output (10%), wages (24%), and investment (19%). Third, this paper relates the increase in industry concentration to the decline in the labor share. My empirical results suggest that the increase in industry concentration can account for most of the decline in the labor share.

This paper is complementary to the independent and contemporaneous work of Gutiérrez and Philippon

(2016) and Autor et al. (2017). Gutiérrez and Philippon (2016) show that a lack of competition and firm short-termism explain under-investment. Industries with more concentration and more common ownership invest less, even after controlling for current market conditions. The authors also find that those firms that under-invest spend a disproportionate amount of free cash flows buying back their shares. Autor et al. (2017) independently discovered a negative industry-level correlation between declining labor shares and increased industry concentration. Their work further uses firm-level data to provide evidence that reallocation across firms has contributed to the decline in the labor share. Taken together, the evidence shows that increases in industry concentration can explain the decline in the labor share, under-investment and a large rise in corporate profits. Consistent with the findings in this paper, the subsequent work of De Loecker and Eeckhout (2017) constructs firm-level markups for publicly traded U.S. firms and finds a large increase in markups since the 1980s and the subsequent work of Hall (2018) constructs industry-level markups and similarly finds a large increase in markups since the 1980s.

3 The Capital and Pure Profit Shares

This section documents a large decline in the capital share and a large increase in the pure profit share of the U.S. non-financial corporate sector over the period 1984–2014. Following Hall and Jorgenson (1967), I compute a series of capital costs equal to the product of the required rate of return on capital and the value of the capital stock. The required rate of return on capital declines sharply, driven by a large decline in the cost of borrowing in financial markets. At the same time, the ratio of capital to gross value added does not sufficiently increase to offset the decline in the required rate of return and as a result the capital share declines. Measured in percentage terms, the decline in the capital share (25%) is much more dramatic than the decline in the labor share (10%). The shares of both labor and capital are declining and are jointly offset by an increase in the share of pure profits.

This section further considers the robustness of the decline in the capital share and the increase in the pure profit share to alternative specifications of the required rate of return, potentially mismeasured inputs into the BEA construction of capital, alternative measures of capital, and potentially omitted or unobserved intangible capital.

3.1 Constructing Capital Costs

3.1.1 Capital Costs

Given an asset-specific specification of the required rate of return, R_s, capital costs for capital of type s are

$$E_s = R_s P_s^K K_s \tag{3.1}$$

where K_s is the quantity of capital of type s, P_s^K is the price of capital of type s, and $P_s^K K_s$ is the nominal value of the stock capital of type s. Note that capital costs are measured in nominal dollars. Aggregate capital costs are the sum of the asset specific capital costs

$$E = \sum_s R_s P_s^K K_s \tag{3.2}$$

We can decompose aggregate capital costs into an aggregate required rate of return on capital and the nominal value of the capital stock

$$\sum_s R_s P_s^K K_s = \underbrace{\sum_s \frac{P_s^K K_s}{\sum_j P_j^K K_j} R_s}_{R} \times \underbrace{\sum_s P_s^K K_s}_{P^K K} \tag{3.3}$$

The first term is the weighted average of the asset-specific required rates of return, where the weight on asset s is proportional to the nominal value of the stock of capital of type s. The second term is the nominal value of the aggregate capital stock.

The capital share of gross value added is

$$S^K = \frac{\sum_s R_s P_s^K K_s}{P^Y Y} \tag{3.4}$$

where $\sum_s R_s P_s^K K_s$ are aggregate capital costs and $P^Y Y$ is nominal gross value added.

To clarify the terminology and units, consider a firm that uses 2000 square feet of office space and 100 laptops. The sale value of the office space is $\$880,000$ at the start of the year. If the required rate of return on the office space is 5% then the capital costs of the office space are $\$44,000 = 0.05 \times \$880,000$ (or \$22 per square foot). The sale value of the 100 laptops is $\$70,000$ at the start of the year. If the required rate of return on the laptops is 41% then capital costs of the laptops are $\$28,700 = 0.41 \times \$70,000$ (or \$287 per laptop). Aggregate capital costs are $\$72,700$ and the value of the aggregate capital stock is $\$950,000$. The aggregate required rate of return on capital is $R = \frac{\$72,700}{\$950,000} \approx 0.08$. If we further assume that the firm's gross

value added for the year is $\$500,000$, then the firm's capital share is $S^K = \frac{\$72,700}{\$500,000} \approx 0.15$.

3.1.2 The Required Rate of Return

The construction of the required rate of return on capital follows Hall and Jorgenson (1967). The required rate of return on capital of type s is

$$R_s = \left(\left(\frac{D}{D+E} i^D (1-\tau) + \frac{E}{D+E} i^E \right) - \mathbb{E}[\pi_s] + \delta_s \right) \frac{1 - z_s \tau}{1 - \tau} \tag{3.5}$$

where D is the market value of debt, i^D is the debt cost of capital, E is the market value of equity, i^E is the equity cost of capital, τ is the corporate income tax rate, $\left(\frac{D}{D+E} i^D (1-\tau) + \frac{E}{D+E} i^E \right)$ is the weighted average cost of capital, π_s is the inflation rate of capital of type s, δ_s is the depreciation rate of capital of type s, and z_s is the net present value of depreciation allowances for capital of type s. This required rate of return accounts for both debt and equity financing as well as the tax treatment of debt and capital.[4] Unlike compensation of employees, firms are unable to fully expense investment in capital and as a result the corporate tax rate increases the firm's capital costs. Since interest payments on debt are tax-deductible, the financing of capital with debt lowers the firm's capital costs.

3.1.3 National Accounting

I assume that the true model of accounting for the U.S. non-financial corporate sector in current dollars is

$$P_t^Y Y_t = w_t L_t + R_t P_{t-1}^K K_t + \Pi_t \tag{3.6}$$

where P_t^Y is the current dollar price of output, $P_t^Y Y_t$ is the current dollar value of gross value added, w_t is the current dollar wage rate and $w_t L_t$ is the total current dollar expenditures on labor, R_t is the required rate of return on capital, P_{t-1}^K is the price of capital purchased in period $t-1$, K_t is the stock of capital used in production in period t and is equal to the stock of capital available at the end of period $t-1$, $R_t P_{t-1}^K K_t$ are current dollar capital costs, and Π_t are current dollar pure profits. This can be written in shares of gross value added as

$$1 = S_t^L + S_t^K + S_t^\Pi \tag{3.7}$$

where $S_t^L = \frac{w_t L_t}{P_t^Y Y_t}$ is the labor share, $S_t^K = \frac{R_t P_{t-1}^K K_t}{P_t^Y Y_t}$ is the capital share, and $S_t^\Pi = \frac{\Pi_t}{P_t^Y Y_t}$ is the pure profit share.

[4] For the tax treatment of capital and debt, see Hall and Jorgenson (1967), King and Fullerton (1984), Jorgenson and Yun (1991), and Gilchrist and Zakrajsek (2007). Past research has included an investment tax credit in the calculation of the required rate of return on capital; the investment tax credit expired in 1986. The results are robust to including the investment tax credit.

In the data, nominal gross value added $P^Y Y$ is the sum of expenditures on labor wL, gross operating surplus, and taxes on production and imports less subsidies. By separating gross operating surplus into capital costs $RP^K K$ and pure profits Π, we get

$$P^Y Y = wL + RP^K K + \Pi + \text{taxes on production and imports less subsidies} \tag{3.8}$$

Unlike taxes on corporate income, it is unclear how to allocate taxes on production across capital, labor, and pure profits. As a share of gross value added, these taxes on production are nearly constant throughout the sample period. Consistent with previous research, I study the shares of labor, capital, and profits without allocating the taxes. Allocating these taxes across labor, capital, and pure profits yields similar results.

3.2 Data

3.2.1 Value Added, Capital, and Taxes

Data for the U.S. non-financial corporate sector are taken from the following sources. Data on nominal gross value added are taken from the National Income and Productivity Accounts (NIPA) Table 1.14 (line 17). Data on compensation of employees are taken from the NIPA Table 1.14 (line 20). Compensation of employees includes all wages in salaries, whether paid in cash or in kind and includes employer costs of health insurance and pension contributions. Compensation of employees also includes the exercising of most stock options;[5] stock options are recorded when exercised (the time at which the employee incurs a tax liability) and are valued at their recorded tax value (the difference between the market price and the exercise price). Compensation of employees further includes compensation of corporate officers. Data on taxes on production and imports less subsidies are taken from the NIPA Table 1.14 (line 23).

Capital data are taken from the Bureau of Economic Analysis (BEA) Fixed Asset Table 4.1. The BEA capital data provide measures of the capital stock, the depreciation rate of capital and inflation for three categories of capital (non-residential structures, equipment, and intellectual property products), as well as a capital aggregate. The 14th comprehensive revision of NIPA in 2013 expanded its recognition of intangible capital beyond software to include expenditures for R&D and for entertainment, literary, and artistic originals as fixed investments. Asset-specific expected capital inflation is constructed as a three-year moving average

[5]There are two major types of employee stock options: incentive stock options (ISO) and nonqualified stock options (NSO). An ISO cannot exceed 10 years, and options for no more than $100,000 worth of stock may become exercisable in any year. When the stock is sold, the difference between the market price and the exercise price of the stock options is reported as a capital gain on the employee's income tax return. The more common stock option used is the NSO. When the option is exercised, the employee incurs a tax liability equal to the difference between the market price and the exercise price (reported as wages); the company receives a tax deduction for the difference between the market price and the exercise price, which reduces the amount of taxes paid. Compensation of employees includes the exercising of NSO, but not the exercising of ISO. For further details see Moylan (2008).

of realized capital inflation. The results are robust to using realized capital inflation instead of expected capital inflation. In addition to the BEA capital data, the main specification includes inventories. Data on inventories are taken from the Integrated Macroeconomic Accounts for the United States Table S.5.a.

The data cover the geographic area that comprises the 50 states and the District of Columbia. As an example, all economic activity by the foreign-owned Kia Motors automobile manufacturing plant in West Point, Georgia is included in the data and is reflected in the measures of value added, investment, capital, and compensation of employees. By contrast, all economic activity by the U.S.-owned Ford automobile manufacturing plant in Almussafes, Spain is not included in the data and is not reflected in the measures of value added, investment, capital, and compensation of employees.

The output and capital data do not include any residential housing. BEA Fixed Asset Table 5.1 indicates that, in addition to non-residential fixed assets (non-residential structures, equipment, and intellectual property products), the corporate sector owns a small amount of residential housing. In all years, residential housing makes up a very small fraction of the value of the fixed assets owned by the U.S. non-financial corporate sector. In 2014, the corporate sector owned $0.19 trillion of residential housing. In the same year, the non-financial corporate sector owned $14.62 trillion of non-residential fixed assets (non-residential structures, equipment, and intellectual property products). In addition, corporate-owned residential housing makes up a very small fraction of total U.S. residential housing. In 2014, the value of residential housing in the private economy was $18.5 trillion. I have not included this stock of residential housing in the calculations. Similarly, the measure of gross value added does not include the $1.66 trillion contribution of residential housing to the gross value added of the private sector. The results are robust to including the corporate-owned residential housing.

Data on the corporate tax rate are taken from the OECD Tax Database and data on the capital allowance are taken from the Tax Foundation.

3.2.2 Debt, Equity, and the Cost of Capital

I approximate the debt cost of capital with the yield on Moody's Aaa bond portfolio. Ideally, we would construct the debt cost of capital as the yield on a representative bond portfolio and adjust for expected default losses. For most of the sample period, there are no readily available measures of the yield on a representative bond portfolio. Starting in 1997, Bank of America Merrill Lynch provides a representative bond portfolio[6] and over the overlapping period of 1997–2014, Moody's Aaa bond portfolio and the Bank

[6]The Bank of America Merrill Lynch US Corporate Master Effective Yield "tracks the performance of US dollar denominated investment grade rated corporate debt publically issued in the US domestic market. To qualify for inclusion in the index, securities must have an investment grade rating (based on an average of Moody's, S&P, and Fitch) and an investment grade rated country of risk (based on an average of Moody's, S&P, and Fitch foreign currency long term sovereign debt ratings). Each security must have greater than 1 year of remaining maturity, a fixed coupon schedule, and a minimum amount outstanding of

of America Merrill Lynch representative bond portfolio display similar levels and trends.[7] In addition, the yield on all debt instruments available through FRED show a large decline and the results are robust to using alternative debt instruments, such as the yield on Moody's Baa bond portfolio or a fixed spread over LIBOR. Moody's (2018) shows that over the sample period the rate of default on bonds has slightly increased and recovery upon default is stable and has no trend, suggesting that expected default losses have remained constant or have slightly increased. As a result, the decline in the yield on corporate bonds likely slightly understates the decline in the debt cost of capital.

Unlike the debt cost of capital, which can be constructed from observed market data, the equity cost of capital is unobserved and requires a model. I approximate the equity cost of capital as the sum of the yield on the ten-year U.S. treasury and a 5% equity risk premium. Typical constructions of the equity cost of capital measure an equity risk premium relative to the yield on a one-year treasury bill. An equity risk premium of 5% relative to a 10-year treasury bond implies an average risk premium of 6.5% relative to the one-year treasury bill that has increased since 2008 to 7.4%. Duarte and Rosa (2015) gather data on 20 existing measures of the equity risk premium from a wide range of models. Appendix A presents the equity cost of capital implied by each of the 20 models. Table A.1 presents a description of the 20 models and Figure A.1 compares the equity cost of capital implied by each of the models to my approximation. The figure shows that the sum of the yield on the ten-year U.S. treasury and a 5% equity risk premium provides a good approximation to both the level and trend of the equity cost of capital. See Duarte and Rosa (2015) for details on the models of the equity risk premium and see Appendix A for further comparison details.

Data on the market value of debt and equity for the U.S. non-financial corporate sector are taken from the Integrated Macroeconomic Accounts for the United States Table S.5.a (debt is the sum of lines 130 and 134, equity is line 140).

3.2.3 Treatment of the Data

Negative values of the required rate of return on capital can and do appear in the data. There are periods in which the cost of capital is so low and expected inflation is sufficiently high that the required rate of return is negative. In the BEA data this occurs for structures in 2006 and 2007 (when we calculate expected inflation as a three-year moving average of realized inflation). I set the negative required rate of return to zero. The results are robust to allowing for negative required rates of return.

$250 million."

[7] With the exception of the Great Recession, the Bank of America Merrill Lynch representative bond portfolio has a yield similar to or below the yield on Moody's Aaa bond portfolio. While Moody's Aaa has a higher grade than the representative portfolio, it also has a longer maturity and this can explain why the two portfolios have similar yields throughout the sample. The yield on Moody's Baa bond portfolio closely tracks the yield on Moody's Aaa bond portfolio, although the yields on the two portfolios have different levels.

3.3 Results

Throughout this subsection, several time series are approximated by a linear time trend. For a variable X, the fitted percentage point (pp) change in X is $\hat{X_{2014}} - \hat{X_{1984}}$, and the fitted percent (%) change in X is $\frac{\hat{X_{2014}} - \hat{X_{1984}}}{\hat{X_{1984}}}$.

3.3.1 The Required Rate of Return

Figure 1 shows the components of the required rate of return on capital for the U.S. non-financial corporate sector over the period 1984–2014. Panel A shows three measures of the cost of capital: the debt cost of capital, equal to the yield on Moody's Aaa bond portfolio; the equity cost of capital, equal to the sum of the risk-free rate (the yield on the ten-year treasury) and the equity risk premium (5%); and the weighted average cost of capital, equal to the weighted average of the post-tax debt cost of capital and the equity cost of capital, where the weight on the debt cost of capital is the ratio of the market value of debt to the sum of the market values of debt and equity. All three measures of the cost of capital show a large decline over the period 1984–2014. Approximating the weighted average cost of capital by a linear time trend shows that the cost of capital declines from 11.1% in 1984 to 6.1% in 2014, a decline of 46%.

Panel B shows two measures of expected inflation: expected capital inflation, equal to a three-year moving average of realized capital inflation; and expected consumption inflation, equal to the median expected twelve-month price change taken from the University of Michigan's Survey of Consumers. Both measures of expected inflation show no trend over the period 1984–2014. While realized inflation is more volatile than expected inflation, realized capital inflation and realized consumption inflation also show no trend over this period. Panel C shows the depreciation rate of capital. There is variation over time in the depreciation rate, but this variation is very small compared to the decline in the cost of capital.

Panel D show the the required rate of return on capital, which was presented in Equation 3.5. The figure shows a clear and dramatic decline in the required rate of return on capital. The decline in the required rate of return tracks the decline in the cost of capital. Approximating the required rate of return by a linear time trend, the required rate of return declines from 18.9% in 1984 to 13% in 2014, a decline of 5.9 percentage points or 31%.

3.3.2 Capital Costs and Pure Profits

Figure 2 shows the capital and pure profit shares of gross value added for the U.S. non-financial corporate sector over the period 1984–2014. Recall from Section 3.1.3 that capital costs are the product of the required rate of return on capital and the value of the capital stock, pure profits are gross value added less compensa-

tion of employees less capital costs less taxes on production and imports plus subsidies, the capital share is the ratio of capital costs to gross value added, and the pure profit share is the ratio of pure profits to gross value added. The required rate of return on capital is calculated in accordance with Equation 3.5.

Panel A shows the capital share of gross value added. The capital share shows a clear and dramatic decline. Approximating the capital share by a linear time trend the capital share declines from 32% of gross value added in 1984 to 24% of gross value added in 2014, a decline of 8 percentage points or 25%. The decline in the capital share (25%) is significantly larger than the decline in the labor share (10%).

Panel B shows the pure profit share of gross value added. The pure profit share shows a clear and dramatic increase. Consistent with previous research,[8] I find that pure profits were very small in the early 1980s. However, pure profits have increased dramatically over the past since the early 1980s. The fitted linear trend shows that pure profits increased from approximately -5.6% of gross value added in 1984 to 8.7% of gross value added in 2014, an increase of 14.3 percentage points.

As the robustness exercises later in this section show, the levels of capital costs and pure profits are somewhat sensitive to the scope of capital, BEA measures of the rate of depreciation, and assumptions on the required rate of return on capital. Alternative assumptions can shift the levels of the capital and profit shares by several percentage points. Furthermore, across specifications, the measured trends in the pure profit share vary from 12.2pp to 19pp.

3.4 Magnitude

The labor share measures the ratio of compensation of employees to labor productivity

$$\frac{wL}{P^Y Y} = \frac{w}{P^Y Y/L}$$

Over the period 1984–2014, labor productivity grew faster than labor compensation. The growing gap between labor productivity and labor compensation is not explained by an increase in capital costs. Back in 1984, every dollar of labor costs were accompanied by 49¢ of capital costs. By 2014, a dollar of labor costs were accompanied by only 41¢ of capital costs. Thus, despite the decline in the labor share, labor costs have increased faster than capital costs.

As a share of gross value added, since the early 1980s firms have dramatically reduced both labor costs and capital costs and increased pure profits. In the main specification, the pure profit share (equal to the ratio of pure profits to gross value added) increases by 14 percentage points. To offer a sense of the magnitude, the value of this increase in pure profits amounts to over $1.2 trillion in 2014, or $15 thousand

[8] See, for example, Rotemberg and Woodford (1995) and Basu and Fernald (1997).

for each of the approximately 81 million employees of the non-financial corporate sector. Across all of the specifications that I consider, the pure profit share has increased by more than 12 percentage points, which amounts to over $1.1 trillion in 2014, or $14 thousand per employee.

3.5 Robustness

This subsection considers the robustness of the decline in the capital share and the increase in the pure profit share to alternative specifications of the required rate of return, potentially mismeasured inputs into the BEA construction of capital, alternative measures of capital, and potentially omitted or unobserved intangible capital.

3.5.1 Alternative Specifications of the Required Rate of Return

The main specification of the required rate of return, presented in equation 3.5, accounts for both debt and equity financing as well as the tax treatment of capital and debt. I now consider two alternative specifications that help us isolate the contribution of tax policy and proper measures of the cost of capital to the measured decline in the capital share and the increase in the pure profit share. In the first alternative specification, the required rate of return on capital of type s is

$$R_s = \left(i^D - \mathbb{E}\left[\pi_s\right] + \delta_s\right) \tag{3.9}$$

where i^D is the debt cost of capital, π_s is the inflation rate of capital of type s, and δ_s is the depreciation rate of capital of type s. This specification matches the required rate of return in standard neo-classical models.[9] The second alternative specification accounts for both debt and equity financing but ignores the role of taxes

$$R_s = \left(\left(\frac{D}{D+E} i^D + \frac{E}{D+E} i^E\right) - \mathbb{E}\left[\pi_s\right] + \delta_s\right) \tag{3.10}$$

where D is the market value of debt, i^D is the debt cost of capital, E is the market value of equity, and i^E is the equity cost of capital.

Table 1 reports the trend of the capital and profit shares for each of the three specifications of the required rate of return on capital. Across the three specifications, the capital share declines between 25% and 36%. The decline in the capital share is at least twice as large as the decline in the labor share. Across the three specifications, the profit share increases between 14.3pp and 16.1pp.

[9] The model of production presented in Section 4 has, in equilibrium, a required rate of return on capital equal to $R_s = (i - (1 - \delta_s)\,\mathbb{E}\left[\pi_s\right] + \delta_s)$. The formula presented in equation 3.9 is more widely used in the literature. In the data, the two versions yield similar results.

3.5.2 Alternative Rates of Depreciation and Capital Inflation

The BEA measures of depreciation rates are based on the work of Hulten and Wykoff (1981).[10] While the BEA has measured rates of depreciation for assets that were not considered by Hulten and Wykoff (1981), there are assets included in the original study for which available data were incomplete and estimated rates of depreciation required strong assumptions. Furthermore, with few exceptions, asset-specific rates of depreciation are assumed to have remained constant over time. Asset-specific capital inflation measures are primarily calculated using the BLS producer price index (PPI) and import price index (IPI), which attempt to incorporate adjustments for changes in quality.[11] Measurement error and changes over time in rates of depreciation and unmeasured quality adjustment to capital could have important implications for the measurement of capital costs and pure profits.

Construction of the nominal value of the capital stock and the required rate of return on capital rely heavily on the BEA measures of depreciation rates and capital inflation. As a result, mismeasured values of the rate of depreciation and capital inflation could have implications for the level and trend in capital costs and pure profits. A higher rate of depreciation would lead us to estimate a lower value of the of the capital stock and at the same time a higher required rate of return on capital. Similarly, higher capital inflation would lead us to estimate a higher value of the capital stock and at the same time a lower required rate of return.

I construct hypothetical fixed asset tables for a wide range of alternative values of the rate of depreciation and capital inflation. I consider values of the rate of depreciation that are between half and two times the value of the BEA measures of depreciation and values of capital inflation that are between -2pp and +2pp of the BEA measures of capital inflation. The considered variation in capital inflation is large given that average aggregate capital inflation over the sample period is 2.4 percent. I consider specifications in which these adjustments are simultaneously made to all BEA categories of assets (structures, equipment, and intellectual property products) as well as specifications in which these adjustments are made to any combination of the BEA categories of assets. For every given time series of asset-specific values of the rate of depreciation $\left(\tilde{\delta}_{s,t}\right)$ and capital inflation $(\tilde{\pi}_{s,t})$, I construct an asset-specific series of the nominal value of capital using the perpetual inventory method $\tilde{P}_{s,t}\tilde{K}_{s,t+1} = \left(1-\tilde{\delta}_{s,t}\right)\tilde{P}_{s,t}\tilde{K}_{s,t} + I_{s,t}$ assuming an initial nominal value of capital at the end of 1974 equal to the BEA reported nominal value of capital. Last, given the newly computed series of capital and the new values of the required rate of return, I compute capital

[10] For a detailed description of the methodology of estimation of BEA depreciation rates see Fraumeni (1997) and https://bea.gov/national/pdf/BEA_depreciation_rates.pdf

[11] For a detailed description of the BLS quality adjustments see U.S. Department of Commerce. Bureau of Economic Analysis. *Fixed Assets and Consumer Durable Goods in the United States*, 1925–99. Washington, DC: U.S. Government Printing Office, September, 2003.

costs and pure profits.

Figure 3 shows the level and trend of the pure profit share for a range of alternative values of the rate of depreciation and capital inflation. For the purpose of this figure, I have simultaneously adjusted the rates of depreciation and capital inflation for all BEA categories of assets. Panels A and B present the fitted change in the pure profit share and the fitted value of the pure profit share in 2014 for a range of adjustments to the rate of depreciation. Panels C and D present the fitted change in the pure profit share and the fitted value of the pure profit share in 2014 for a range of adjustments to capital inflation. Panel A shows that across a wide range of alternative values for the rate of depreciation the fitted change in the pure profit share ranges from 12.9pp to 14.1pp. There is almost no change to the fitted change of the pure profit share for higher rates of depreciation. Panel B shows that across a wide range of alternative values for the rate of depreciation the fitted value of the pure profit share in 2014 ranges from 7.3pp to 9.9pp. A higher rate of depreciation implies a higher level but a nearly identical trend of the pure profit share. Panels C and D show that the level and trend of the pure profit share vary by less than half a percentage point across a wide range of alternative values of capital inflation. The results are similar or even smaller in magnitude when I apply the adjustments to any other combination of the BEA categories of assets.

3.5.3 Alternative Measures of Capital

In the main specification, capital consists of BEA capital (structures, equipment, and intellectual property products) as well as inventories. I now consider two alternative specifications of capital. The first alternative specification only uses the BEA measures of capital. This measure is widely used in practice and thus allows for a better comparison of the results to existing research. The second alternative specification includes the BEA measures of capital, inventories, and values real estate at market prices instead of at replacement cost (the difference is often thought of as the value of land). Data on the market value of real estate are taken from the Integrated Macroeconomic Accounts for the United States Table S.5.a.

Table 2 presents the results of the analysis. Each column in Table 2 uses a different measure of capital. Column 1 includes the BEA measures of capital as well as inventories. Column 2 includes BEA capital and excludes inventories. Column 3 includes BEA measures of capital, inventories, and values real estate at market prices instead of at replacement cost. It is easily noticeable from this table that more inclusive measures of capital lead to larger declines in the capital share and larger increases in the pure profit share. The reason for this is straightforward: over the period 1984–2014 the required rate of return on all forms of capital declines sharply. Since the value of the additional capital does not grow sufficiently fast relative to output, inclusion of this additional capital results in an even greater decline in the capital share and increase in the pure profit share.

3.5.4 Potentially Omitted or Unobserved Intangible Capital

The BEA measures of capital include physical capital, such as structures and equipment, as well as measures of intangible capital, such as R&D, software, and artistic designs. Despite the BEA's efforts to account for intangible capital, it is possible that there are forms of intangible capital that are not included in the existing BEA measures. Indeed, past research has considered several forms of intangible capital that are not currently capitalized by the BEA and has argued that these are important for explaining asset valuations and cash flows.[12] These additional forms of intangible capital include organizational capital, market research, branding, and training of employees. Might the high level of pure profits and the large increase in the pure profit share measured in Section 3.3 reflect large and increasing cash flows that are the return to missing or unobserved capital?

The effect of including an additional form of capital unambiguously increases capital costs. Since the required rate of return on this additional capital is positive (or at least non-negative), the user of this capital incurs positive annual capital costs. Next, the inclusion of additional capital very likely increases gross value added. Current measures of value added exclude firm investment in this additional capital and therefore underestimate gross value added by the value of the investment. So long as investment in this capital is positive, gross value added is understated. The effect on pure profits is ambiguous: on the one hand, capital costs are now a larger portion of recorded value added and, on the other hand, recorded value added understates true value added. The inclusion of this additional capital will reduce pure profits if capital costs are larger than investment. A few lines of simple algebra show that so long as capital costs of this additional capital are larger than investment, accounting for this additional capital increases the capital share and decreases the pure profit share.

While it is easy to work out the effect of including an additional form of capital on the *level* of the capital and pure profit shares, its effects on the *trends* of the capital and pure profit shares are less clear. Since the early 1980s the required rate of return on all forms of capital declined sharply, due to a large decline in the cost of capital. This decline in the cost of capital equally affects the required rate of return on any additional form of capital. As a result, if the stock of additional capital grows only at the rate of output, then the additional capital costs will grow far slower than output. This will have the effect of further reducing the trend of the capital share and further increase the trend of the pure profit share. As we saw in Section 3.5.3, the inclusion of additional forms of capital often leads to an even greater decline in the capital share and increase in the pure profit share. In order for this additional capital to have any mitigating effect on the trends of the shares of capital and pure profits, the stock of additional capital would need to grow

[12] See, for example, Hall (2001), Atkeson and Kehoe (2005), Hansen, Heaton and Li (2005), Hulten and Hao (2008), Corrado, Hulten and Sichel (2009), McGrattan and Prescott (2010), and Eisfeldt and Papanikolaou (2013).

significantly faster than output. In order for this additional capital to completely offset the observed trends of the shares of capital and pure profits, the stock of additional capital would need to grow far faster than output.

I take two approaches to assessing the contribution of omitted intangible capital to the measured increase in pure profits. First, I incorporate the most comprehensive existing measures of omitted intangible capital into the analysis. Second, I construct a large number of scenarios for omitted intangible capital. Each scenario is a parameterization of investment, depreciation, and capital inflation of intangible capital. For each scenario I compute capital costs and pure profits that fully incorporate the unobserved investment. I find that existing measures of intangible capital are unable to explain the rise in pure profits. Of the large number of scenarios that I consider, none can fully account for the rise in pure profits. There are scenarios that can account for most of the increase in pure profits, but in all such scenarios the value of missing intangible capital in 2014 would need to be larger than all capital measured by the BEA (structures, equipment, intellectual property products).

An increase in the importance of omitted intangible capital and a rise in pure profits are not mutually exclusive. Of the many scenarios of omitted intangible capital that I consider, many feature a simultaneous increase in intangible capital as well as a large increase in pure profits. In this sense, the measured rise in pure profits is consistent with many scenarios that feature rapidly increasing intangible capital.

Setup The conceptual framework for incorporating unobserved intangible capital follows Corrado, Hulten and Sichel (2009) and McGrattan and Prescott (2010).

- The additional capital costs are equal to $R^X P^X X$, where $P^X X$ is the nominal value of the unobserved stock of capital and $R^X = \left(\left(\frac{D}{D+E} i^D (1-\tau) + \frac{E}{D+E} i^E\right) - \mathbb{E}\left[\pi^X\right] + \delta^X\right) \frac{1-z^X \times \tau}{1-\tau}$ is the required rate of return on the unobserved capital.[13] True capital costs are the sum of observed capital costs and unobserved capital costs $R^K P^K K + R^X P^X X$.

- True gross value added is the sum of observed gross value added $P^Y Y$ and unobserved investment I^X.

- True pure profits are observed pure profits, Π, less unobserved capital costs plus unobserved investment

$$\Pi^{TRUE} = \left(\underbrace{P^Y Y + I^X}_{\text{true gross value added}}\right) - \left(\underbrace{R^K P^K K + R^X P^X X}_{\text{true capital costs}}\right) - wL \tag{3.11}$$

$$= \Pi - R^X P^X X + I^X \tag{3.12}$$

[13] Since firms can expense all investment in this intangible capital, the tax system does not distort the accumulation of such capital, other than through the tax shield of debt. Said differently, the depreciation allowance of intangible capital is 1.

Approach #1: Existing Measures The first approach that I take to assessing the potential contribution of unmeasured intangible capital to the measured increase in pure profits is to explicitly incorporate existing measures of intangible capital. Much of the intangible capital considered by Corrado et al. (2016) is already included in the BEA Fixed Asset Tables and is therefore already accounted for in the baseline measures of capital costs and pure profits that appear in Section 3.3. The category of intangible capital that is measured by Corrado et al. (2016) but is not included in the BEA data is called "Economic Competencies" and includes the value of all market research, advertising, training, and organizational capital. The data on measured investment in intangible capital for the U.S. non-financial business sector are available through IntanInvest.

Using the provided data on nominal investment, price deflators, and depreciation rates, I construct a nominal stock of capital by the perpetual inventory method.[14] I then construct corrected measures of capital costs, gross value added, and pure profits for each year in which the intangible capital data are available (1996–2013).[15] I find that the inclusion of economic competencies has modest effects on the level of pure profits. The inclusion of economic competencies accounts for pure profits that are on average equal to 0.2% of gross value added and that never exceed 1.75% of gross value added. I further find that the inclusion of economic competencies has modest effects on the trend in pure profits. Approximating the annual contribution of economic competencies to the pure profit share by a linear time trend, I find that the inclusion of economic competencies can explain an annual increase of 0.046 percentage points. This annual estimate implies that economic competencies can account for a 1.4 percentage point increase in the pure profit share over the period 1984–2014. This amounts to 10% of the measured increase in the pure profit share presented in Section 3.3.

Approach #2: Scenario Analysis The second approach that I take to assessing the potential contribution of unmeasured intangible capital to the measured increase in pure profits is to construct a wide rage of scenarios. Each scenario is a hypothetical account of unmeasured intangible capital. For each scenario, I construct a hypothetical aggregate series of pure profits that fully accounts for the contribution of the hypothetical fixed asset.

Table 3 summarizes the functional form assumptions and the range of parameter values that I use for the construction of unmeasured intangible capital. The construction of a scenario requires assumptions on investment $\left(I_t^X\right)$, capital inflation $\left(\pi_t^X\right)$, the depreciation rate $\left(\delta^X\right)$ of unmeasured intangible capital, and

[14] For each type of capital, I initialize the the nominal value of the stock of capital using the equation $P_{-1}^K K_0 = \frac{P_0^I I_0/(1+\bar{\pi})}{g+\delta}$, where $P_0^I I_0$ is the nominal value of investment, $\bar{\pi}$ is the average rate of capital inflation over the sample period, g is the growth rate of real investment estimated using the first five years of data, and δ is the rate of depreciation. Given the high rates of depreciation, the estimated initial nominal value of the capital stock is not very sensitive to the method of estimating growth rates of real investment.

[15] Due to the limited time series, I construct expected capital inflation as realized capital inflation.

an initial stock of unmeasured intangible capital $\left(P_{t_0}^X X_{t_0}\right)$. Allowing for, but not requiring, investment that is growing faster than output, I assume a rate of investment of the form $\frac{I_t^X}{P_t^Y Y_t} = a + b \times (t - 1984)$, where $P_t^Y Y_t$ is measured gross value added. Allowing for, but not requiring, a time trend in the relative price of unmeasured intangible capital, I assume a path of capital inflation of the form $\pi_t^X = \pi_t^Y + c + d \times (t - 1984)$, where π_t^Y is the percentage change in the price deflator for the non-financial corporate sector (taken from NIPA Table 1.14). I assume a fixed depreciation rate e and an initial stock of unmeasured intangible capital in 1975. The nominal value of unmeasured capital at the end of period t is constructed by the perpetual inventory method and is given by the equation $P_t^X X_{t+1} = \left(1 - \delta^X\right) P_t^X X_t + I_t^X$.

For a given scenario, I make the following adjustments to gross value added, capital costs, and pure profits. Adjusted gross value added is the sum of measured gross value added and investment in unmeasured intangible capital. Adjusted capital costs are the sum of measured capital costs and unmeasured capital costs. Adjusted pure profits are adjusted gross value added less adjusted capital costs. To facilitate comparison, the outcome that I measure is the ratio of adjusted pure profits to measured gross value added. The results are similar when I consider the ratio of adjusted pure profits to adjusted gross value added.

Of the large number of scenarios that I consider, none can fully account for the rise in pure profits. Some scenarios can account for most of the increase in pure profits (up to 75%). All of the scenarios that manage to account for at least half of the rise in the pure profit share the following features. First, the value of missing intangible capital in 2014 needs to be at least \$14.6 trillion, which is 170% of observed gross value added and is larger than all capital measured by the BEA (structures, equipment, intellectual property products). Second, the rate of depreciation needs to be very low (no larger than 10%).

We can compare these scenarios to the BEA measures of intellectual property products and economic competencies, which is the class of intangible capital that is not capitalized by the BEA and has been measured by Corrado, Hulten and Sichel (2009). The value of the stock of intellectual property products in 2014 is only 22% of observed gross value added and the value of the stock of economic competencies in 2013 (the last year for which the data are available) is only 19% of observed gross value added. Furthermore, the fitted rate of depreciation of intellectual property products is 23% and that of economic competencies is 44%. If we restrict attention to those scenarios that feature a rate of depreciation of at least 10%, then no such scenario can explain more than 54% of the rise in pure profits and in order to explain even one third of the rise in pure profits the value of missing intangible capital in 2014 needs to be at least \$11.4 trillion, which is 130% of observed gross value added.

3.6 Pure Profits Implied by Market Valuations

Pure profits are reflected in measures of corporate valuations and profitability. Lindenberg and Ross (1981) and Salinger (1984) provide theoretical and empirical support that relates Tobin's q, the ratio of the market value of a firm to the replacement value of assets, to market power and pure profits. A recent empirical literature finds evidence that increases in concentration and barriers to entry increase the market value of incumbent firms (Grullon, Larkin and Michaely (2016); Bessen (2016)).

In this subsection, I present a measure of aggregate pure profits that are derived from aggregate market valuations. I compare the *stock* measure of pure profits to the *flow* measure of pure profits presented earlier in this section and lay out the assumptions that facilitate comparison.

3.6.1 Stock Measures of Pure Profits

I view market valuations as the sum of two distinct components: the net present value of capital costs and the net present value of pure profits

$$\text{Market Value} = \text{NPV(capital costs)}+\text{NPV(pure profits)} \tag{3.13}$$

Given an estimate of the net present value of capital costs, we can construct the net present value of pure profits as

$$NPV\,(\widehat{\text{pure profits}}) = \text{Market Value - } NPV\,(\widehat{\text{capital costs}}) \tag{3.14}$$

In order to derive a measure of pure profits from market valuations and compare the stock and and flow measures of pure profits I make two strong assumptions. First, I assume that at each point in time capital costs and pure profits are expected to grow at the same constant rate g and are discounted as the same rate i (both nominal). Second, I assume that the nominal value of the capital stock is equal to the net present value of capital costs.

The first assumption allows us to relate current period capital costs and pure profits to the NPV of all future capital costs and pure profits. Under this assumption we can compute the NPV of capital costs and pure profits using a Gordon growth formula

$$\text{NPV(capital costs)} = \frac{\text{capital costs}}{i-g} \tag{3.15}$$

$$\text{NPV(pure profits)} = \frac{\text{pure profits}}{i-g} \tag{3.16}$$

Under the first assumption, we can relate the relative stock-values to the relative flow-values. There are many ways of presenting the comparison of the relative stock-values to the relative flow-values; in order to present the results in a commonly used set of units, I present this relationship as

$$\frac{\text{NPV(capital costs)+NPV(pure profits)}}{\text{NPV(capital costs)}} = \frac{\text{capital costs + pure profits}}{\text{capital costs}} \tag{3.17}$$

The numerator on the left-hand side is market value and the numerator on the right-hand side is gross operating surplus. Neither numerator requires an estimate of capital costs or pure profits.

The second assumption gives us the net present value of capital costs. This second assumption holds in models of frictionless adjustments to the capital stock, but fails in the large class of models with adjustment costs. Combining the second assumption with equation 3.17 we have

$$\frac{\text{Market Value}}{P^K K} = \frac{\text{gross operating surplus}}{\text{capital costs}} \tag{3.18}$$

This equation allows us to translate Q, the ration of market value to capital, to implied capital costs and pure profits. If Q is equal to 1.25 then the net present value of capital costs are 80% of total market value, implied capital costs are 80% of gross operating surplus, and implied pure profits are the remaining 20% of gross operating surplus.

The implementation of this approach to measuring capital costs and pure profits only requires data on market values of debt and equity and the nominal value of capital. Unlike the flow measures of capital costs and pure profits presented earlier in this section, this approach does not require an estimate of the required rate of return on capital or capital costs. Consistent with the main specification presented earlier in this section, capital consists of BEA capital (structures, equipment, and intellectual property products) as well as inventories.

3.6.2 Results

Before presenting the time series of the results, it might be helpful to go through a particular year in detail. As an example consider 2010. The ratio of the market value to the nominal value of capital is 1.43. Under the assumptions stated above, this ratio implies that the capital stock is about 70% of the total market value and therefore capital costs should equal 70% of gross operating surplus. Since gross operating surplus are \$2.45 trillion, implied capital costs are \$1.71 trillion and implied pure profits are \$0.74 trillion. Dividing by gross value added, the stock based measures imply a capital share of 24% and a pure profit share of 10%. If we take the view that market value in excess of the value of capital is the net present value of pure profits,

then we would conclude based on the 2010 market value of the U.S. non-financial corporate sector and the nominal value of the capital stock that pure profits are 10% of gross value added. This calculation does not rely on any assumptions of the required rate of return on capital or its components (cost of borrowing in financial markets, depreciation rates, or quality adjustments).

I extend this calculation to the U.S. non-financial corporate sector over the period 1984–2014. Approximating the implied pure profit share by a linear time trend, I find that the market-valuation implied pure profit share increases from -1.3% in 1984 to 15.4% in 2014, a 16.7 percentage point increase. The level of the implied pure profit share is somewhat affected by the high market valuations during the dot-com period. When I exclude the years 1998–2001, I find that the linear approximation to the pure profit share is nearly one percentage point lower in level (14.6% in 2014), but is nearly identical in trend (16.6 percentage point increase). The market-valuation implied pure profit share is very similar in trend and level to the flow measures of the pure profit share presented earlier in this section.

3.7 Discussion

3.7.1 Measurements of the Capital Share

The measurement of the capital share in this paper builds on the work of Karabarbounis and Neiman (2014) and Rognlie (2015). Karabarbounis and Neiman (2014) and Rognlie (2015) study the decline in the labor share and additionally provide an estimate of the capital share. In both cases, the authors find that the capital share does not sufficiently increase to offset the decline in labor and furthermore the capital share might decrease slightly.

In their measurement, Karabarbounis and Neiman (2014) decompose the capital share into product of three components

$$\frac{RP^K K}{P^Y Y} = R \times \frac{P^K K}{P^I I} \times \frac{P^I I}{P^Y Y} \tag{3.19}$$

where the first component is the required rate of return, the second component is the ratio of the nominal value of capital to investment and the third component is the ratio of nominal investment to gross value added.

The authors assume that the required rate of return on capital is constant and that the ratio of the nominal value of the capital stock to nominal investment is constant.[16] These assumptions lead the authors to measure the percentage change in the capital share as the percentage change in the ratio of investment to gross value added. Figure 4 plots the ratio of investment to gross value added in the U.S. corporate

[16]See Section IV.B of Karabarbounis and Neiman (2014) for their construction of the capital share, as well as for their assumptions of a constant ratio of the nominal value of the capital stock to nominal investment and a constant required rate of return on capital.

sector using the NIPA data. The figure shows that the ratio of investment to value added has no linear time trend: the estimated linear time trend is economically small and statistically zero.[17] Thus, the methodology of Karabarbounis and Neiman (2014), when applied to the U.S. non-financial corporate sector, does not suggest a decline in the capital share.

Rognlie (2015) provides two measures of the capital share.[18] In the first measure, the author assumes that the required rate of return on capital is constant. This assumption leads the author to measure the percentage change in the capital share as the percentage change in the ratio of the value of the capital stock to gross value added. Using this measure, Rognlie (2015) finds a slight increase in the capital share. These results are consistent with my findings: I find that the ratio of the value of the capital stock to gross value added is increasing slightly over the period 1984–2014. In the second measure, the author constructs a time series of the real interest rate from the market and book values of the U.S. corporate sector. This construction of the real cost of capital produces values that are inconsistent with observed market data. Most importantly, the construction does not match the observed decline in market prices. When combining NIPA data with the cost of capital presented in Rognlie (2015), I find no decline in the capital share.[19]

Similar to their work, this paper uses capital data to discipline the capital share. The point of departure from their work is the use of market prices to measure debt and equity costs of capital. As shown in Section 3.3, the cost of capital nearly halves over the period 1984–2014 and the required rate of return on capital sharply declines. The capital stock does not grow fast enough to offset the large decline in the required rate of return and as a result the capital share declines. Measures of the capital share that assume a constant required rate of return show no decline; measures of the capital share that incorporate market prices show a large decline.

While this paper focuses on the U.S. non-financial corporate sector, there is reason to believe that many other countries experience a decline in the capital share. Karabarbounis and Neiman (2014) show that the rate of investment does not increase in many advanced economies. At the same time, many advanced economies experience large declines in the cost of capital. Indeed, the large decline in the cost of capital and the constant investment rate suggest that the capital share may be declining globally. Further research is needed to study the capital share in other countries.

[17] These results are not directly comparable to Karabarbounis and Neiman (2014), Figure IX. There are two main differences. First, Figure IX is constructed using GDP data rather than corporate data. The GDP data include investment in residential housing and the contribution of residential housing to GDP; see Rognlie (2015) for a detailed discussion of the role of residential housing. Second, Figure IX is constructed using data for the period 1975–2011. The ratio of U.S. non-financial corporate investment to gross value added has no time trend over the period 1975–2011.

[18] See Section II.B of Rognlie (2015) for the construction of the capital share.

[19] The cost of capital is presented in Rognlie (2015), Figure 7. The figure shows estimated constant, linear, and quadratic approximations to the cost of capital. The constant and quadratic approximations do not decline over the period 1984–2014. Thus, using these approximations leads to a slight increase in the capital share. The linear approximation shows a small decline in the cost of capital, equal to 2pp every 25 years. When I calculate the required rate of return on capital using this linear approximation to the real cost of capital, I find no decline in the capital share.

3.7.2 Production-Based Measures of Markups

De Loecker and Eeckhout (2017) provide production-based estimates of markups for non-financial U.S. public firms. Unlike my estimates of pure profits, the production-based estimates of markups do not impute capital costs, nor do they rely on time-series variation in capital or on assumptions of the required rate of return on capital and its components. Instead, the production-based approach estimates a production function and backs out markups from the firm's first-order conditions. Consistent with my findings, the authors find a rise in markups since the early 1980s. At the same time, our implied series of the pure profit share display notable differences in magnitude.

In their work, De Loecker and Eeckhout (2017) find that markups increased from 1.2 in the early 1980s to 1.6 in 2014. These numbers are not directly comparable to the pure profit share that I report in this section or to the model-based markups that appear in Section 4. Unlike the estimates that I report, the authors measure sales-based markups rather than value added based markups. In order to convert these markup estimates into a series of the pure profit share of gross value added I adopt the following procedure. First, I construct the pure profit share of sales implied by the reported markups. Second, I convert the pure profit share of sales into a pure profit share of gross value added.

In the first step, I compute the pure profit share of sales implied by the markup using the equation

$$\text{markup} = \text{scale of production} \times (1 - \text{pure profit share of sales})^{-1} \tag{3.20}$$

With constant returns to scale, the reported markup of 1.2 implies a pure profit share of sales equal to 17% of sales and a markup of 1.6 implies a pure profit share of sales equal to 38%. If we assume a higher scale of production equal to 1.1 then the authors' markup estimates imply that the pure profit share of sales was 8% in the early 1980s and 31% in 2014. In the second step, I multiply the pure profit share of sales by the ratio of sales to gross value added. Census data on sales and BEA data on value added for the non-financial private sector show that the ratio of sales to gross value added is around 2.6 over this period. Even when we assume a high scale of production (1.1) the authors' markup estimates imply that the pure profit share of gross value added was 22% in the early 1980s and 81% in 2014. Both the level and trend of these implied values of pure profits are an order of magnitude larger than those that I find.[20]

[20] These implied pure profits are implausibly high from a macroeconomic perspective: so long as capital costs are non-negative, pure profits can't exceed gross value added less compensation of employees. This bound implies that pure profits in 2014 can't exceed 42% of gross value added.

3.7.3 Long-Run Trends

Following the existing literature on the decline in the labor share, this paper focuses on the period starting in the early 1980s. Trying to explain the decline in the labor share over this period, past research has argued that firms have substituted labor for physical capital. As the results of this section show, the decline in the labor share since the early 1980s was not offset by an increase in the capital share. Despite the decline in the labor share, labor costs have in fact increased faster than capital costs. This evidence argues strongly against these existing theories of the decline in the labor share.

Barkai and Benzell (2018) extend the measurement of capital costs and pure profits to the period 1946–2015. Measuring capital costs and pure profits over an extended time period presents a significant empirical challenge, especially measuring expected capital inflation in periods of high and volatile inflation. To overcome this and other measurement challenges, the authors consider alternative measures of pure profits that are not likely to be subject to the same sources of measurement error. The authors find that (i) pure profits were declining in the decades following the Second World War, (ii) pure profits have been increasing since the early 1980s, and (iii) the early 1980s are a point of sudden change. As a share of gross value added, pure profits today are higher than they were in 1984, but lower than their value in the late 1940s. These features of the data are remarkably robust across the different measures of pure profits.

The longer time horizon allows us to gain some additional insight into the possible explanations for the rise in pure profits since the early 1980s. Adjustment costs to physical capital are one possible source of pure profits. If it takes time for businesses to build up their production capacity, other firms can make pure profits while their competitors catch up. The central prediction of this theory is that high pure profits are accompanied by high investment. Contrary to the predictions of this theory, the data show that declining pure profits (1946–1984) were in fact accompanied by increasing investment and the later increasing pure profits (1984–2015) were accompanied by declining investment. An alternative theory focuses on unmeasured intangible capital. As described earlier in this section, some of the measured pure profits are likely a return to unmeasured intangible investments. While this theory may be able to partially explain the *level* of pure profits, the above analysis shows that the growth of mismeasurement would have to be extraordinarily large to explain the *trend* increase in pure profits since the 1980s. Moreover, this theory is silent on the high pure profits of the post-WW2 decades and the sudden change in the early 1980s.

Secular changes in competition are a natural explanation to consider for the fall and the rise in pure profits. Two notable policy changes point to the early 1980s as a possible break in the trends in competition. First, there was an increase in antitrust enforcement from the mid-1940s to the early 1980s, followed by a decline from the early 1980s to the present. Second, the Department of Justice adopted a more lenient

merger guideline in 1982. This explanation is consistent with the theoretical findings of Section 4 and the cross-sectional empirical evidence of Section 5. See Barkai and Benzell (2018) for further details and a discussion of the possible explanations for the rise in pure profits since the early 1980s.

3.7.4 Contribution of BEA Intellectual Property Products

Koh, Santaeulàlia-Llopis and Zheng (2016) present evidence that the BEA's expanded recognition of intellectual property products (IPP) as a fixed asset in 2013 has contributed to the measured decline in the labor share. The authors further argue that the decline in the labor share reflects a transition to a more IPP-intense economy.

In its 14th comprehensive revision of NIPA in 2013, the BEA expanded its recognition of intangible capital beyond software to include expenditures for R&D and for entertainment, literary, and artistic originals as fixed investments. The BEA's expanded recognition of IPP as a fixed asset affects both the level and trend of the labor share. Any recognition of additional investment in fixed assets increases measured gross value added in each and every year by the nominal value of investment. This in turn increases the denominator of the labor share and therefore reduces its level. To the extent that investment in the newly recognized components of IPP has increased faster than output, the expanded recognition of IPP in the national accounts leads to a decline in the labor share.

Unlike most of the existing literature on the labor share, Koh, Santaeulàlia-Llopis and Zheng (2016) measure a linear trend in the labor share over the entire post-war period (1947–2014). Elsby, Hobijn and Şahin (2013) and Karabarbounis and Neiman (2014) who document the decline in the U.S. and global labor share provide evidence of a decline since the early 1980s. Moreover, these papers use data that predates the 2013 BEA revision. Using current BEA data, we can assess the impact of the expansion of IPP on the decline in the labor share since the 1980s.[21] I find that the expanded recognition of IPP capital leads to a measured labor share that is on average 2pp lower over the period 1984–2014. However, I find that the expanded recognition of IPP capital had no effect on the trend in the labor share. Approximating the labor share by a linear time trend over this period, I find that current BEA measures of the labor share show an estimated decline of 6.7pp. Once I remove all investment in newly recognized forms of IPP capital from gross value added, I find an estimated decline in the labor share of 6.7pp. These results show that the decline in the labor share since the early 1980s is not a result of the BEA's expanded recognition of IPP capital.

We can empirically consider measures of the labor share that are not affected by the recognition of IPP

[21] Unfortunately, the BEA does not provide a decomposition of IPP capital for the non-financial corporate sector. Using data on non-residential investment in the different types of IPP capital taken from BEA Fixed Asset Table 2.7, I construct a time series of the ratio of newly recognized IPP to total IPP and multiply this ratio by total non-financial corporate investment in IPP.

capital. Using the census data presented in Section 5, I find that the labor share of sales declines in 70% of U.S. industries over the period 1997–2012 (data limitations do not allow me to consider a longer time period). In half of all industries the labor share of sales declines at least 10%. Unlike gross value added, census measures of sales do not depend on the treatment of IPP capital and as a result the measured decline in the labor share of sales in the majority of U.S. industries is unaffected by the expanded recognition of IPP capital.

Last, my measurement of capital costs presented earlier in this section includes all IPP capital. Furthermore, the model in Section 4 is calibrated to match all BEA capital, including IPP. In this sense, my findings account for the contribution of IPP capital.

3.7.5 Labor Income in Disguise

Smith et al. (2017) present evidence that some portion of top private business income is wage income in disguise. Owner-managers of S-corporations have a tax incentive to misreport their income as business income rather than wages. Using detailed administrative tax data, the authors find that, on average, when a business changes its legal structure from a C-corporation to an S-corporation its labor share of sales drops by 1.95%. The authors estimate that in the year 2012, $116 billion of aggregate S-corporation profits should have been classified as labor income. Furthermore, the authors find that misreporting likely leads to an overestimate of the decline in the labor share of 1.2 percentage points over the period 1980–2012.[22] Given these results, it is likely the case that my measured decline in the labor share is overstated by 1.2 percentage points and my measured increase in the pure profit share is overstated by 1.2 percentage points.

4 Model of the Corporate Sector

In this section I present a standard general equilibrium model of monopolistic competition to study the decline in the shares of labor and capital. The model in this section is standard in order to ensure that the results are not due to novel modeling features, but rather are a direct consequence of the measurement of the capital share.

The model allows for changes in technology, preferences, relative prices, and competition. While changes to preferences, technology, and relative prices can cause firms to shift from labor to capital, and as a consequence can cause the labor share to decline at the expense of the capital share, these mechanisms cannot cause a simultaneous decline in the shares of both labor and capital. An decline in competition and

[22]To account for possible differences in sample period, I repeat the authors' calculation for the period 1984–2013 (the IRS data end in 2013) and find that misreporting likely leads to an overestimate of the decline in the labor share of 1.2 percentage points over this period.

increase in markups is necessary to match a simultaneous decline in the shares of labor and capital.

I calibrate the model to the U.S. non-financial corporate sector and show that the decline in competition inferred from the data can quantitatively match the decline in the shares of both labor and capital. Using the calibrated model, I further explore the welfare implications of the decline in competition. Across a range of parameter values, the model finds that the decline in competition has led to large gaps in output (8.2% to 10%), wages (18.8% to 19.4%), and investment (14.1% to 19.8%).

4.1 Model

4.1.1 Final Goods Producer

The corporate sector is made up of a unit measure of firms, each producing a differentiated intermediate good. The final good is produced in perfect competition as a CES aggregate of the intermediate goods

$$Y_t = \left(\int_0^1 y_{i,t}^{\frac{\varepsilon_t - 1}{\varepsilon_t}} di \right)^{\frac{\varepsilon_t}{\varepsilon_t - 1}} \tag{4.1}$$

where $\varepsilon_t > 1$ is the elasticity of substitution between goods. The pure profits of the final goods producer are $P_t^Y Y_t - \int_0^1 p_{i,t} y_{i,t} di$, where P_t^Y is the exogenous price level of output and $p_{i,t}$ is the endogenous price of intermediate good i. The solution to the cost minimization problem, together with the zero pure profit condition of the final goods producer, leads to the following demand function for intermediate good i:

$$D_t\left(p_{i,t}\right) = Y_t \left(\frac{p_{i,t}}{P_t^Y} \right)^{-\varepsilon_t} \tag{4.2}$$

4.1.2 Firms

Firm i produces intermediate good $y_{i,t}$ using the constant return to scale production function

$$y_{i,t} = f_t\left(k_{i,t}, l_{i,t}\right) \tag{4.3}$$

where $k_{i,t}$ is the amount of capital used in production and $l_{i,t}$ is the amount of labor used in production. In period $t-1$ the firm exchanges one-period nominal bonds for dollars and purchases capital $k_{i,t}$ at the nominal price P_{t-1}^K. In period t the firm hires labor in a competitive spot market at the nominal wage rate w_t and produces good $y_{i,t}$, which is sold at price $p_{i,t}\left(y\right)$. After production the firm pays the face value of its

debt and sells the undepreciated capital at the nominal price P_t^K. The firm's nominal pure profits are

$$\begin{aligned}\pi_{i,t} &= \max_{k_{i,t},l_{i,t}} p_{i,t}y_{i,t} - (1+i_t)\,P_{t-1}^K k_{i,t} - w_t l_{i,t} + (1-\delta_t)\,P_t^K k_{i,t} \\ &= \max_{k_{i,t},l_{i,t}} p_{i,t}y_{i,t} - R_t P_{t-1}^K k_{i,t} - w_t l_{i,t} \end{aligned} \tag{4.4}$$

where $R_t = i_t - (1-\delta_t)\,\frac{P_t^K - P_{t-1}^K}{P_{t-1}^K} + \delta_t$ is the required rate of return on capital.

The pure profit maximization problem of the firm determines the demand for labor and capital inputs, as well as pure profits, as a function of the current period nominal interest rate, the current period nominal wage rate, and aggregate output. The first-order condition for capital is $p_{i,t}\frac{\partial f}{\partial k} = \mu_t R_t P_{t-1}^K$, where $\mu_t = \frac{\varepsilon_t}{\varepsilon_t - 1}$ is the equilibrium markup over marginal cost. Similarly, the first-order condition for labor is $p_{i,t}\frac{\partial f}{\partial l} = \mu_t w_t$. Integrating demand across firms determines the corporate sector demand for labor and capital inputs, as well as pure profits, as a function of the nominal interest rate, the nominal wage rate, and aggregate output.

4.1.3 Households

A representative household is infinitely lived and has preferences over its consumption $\{C_t\}$ and its labor $\{L_t\}$ that are represented by the utility function

$$\sum_t \beta^t U\left(C_t, L_t\right) \tag{4.5}$$

The economy has a single savings vehicle in the form of a nominal bond: investment of 1 dollar in period t pays $1 + i_{t+1}$ dollars in period $t+1$. In addition to labor income and interest on savings, the household receives the pure profits of the corporate sector. The household chooses a sequence for consumption $\{C_t\}$ and labor $\{L_t\}$ to maximize utility subject to the lifetime budget constraint

$$a_0 + \sum_t q_t\left[w_t L_t + \Pi_t\right] = \sum_t q_t P_t^Y C_t \tag{4.6}$$

where a_0 is the initial nominal wealth of the household, $q_t = \prod_{s \le t}\left(1+i_s\right)^{-1}$ is the date zero price of a dollar in period t, w_t is the nominal wage in period t, Π_t are nominal corporate pure profits in period t, and P_t^Y is the price of a unit of output in period t.

The utility maximization problem of the household determines the supply of labor and nominal household wealth as a function of the path of nominal interest rates, the path of nominal wage rates, and the net present value of nominal corporate pure profits. The inter-temporal first-order condition of the household [Euler equation] is $1 = \beta\left(1+i_{t+1}\right)\left(1+\frac{P_{t+1}^Y - P_t^Y}{P_t^Y}\right)^{-1}\frac{U_c(C_{t+1},L_{t+1})}{U_c(C_t,L_t)}$ and the intra-temporal first-order condition

[MRS] is $U_l(C_t, L_t) = -\frac{w_t}{P_t^Y} U_c(C_t, L_t)$. The nominal wealth of the household follows the path

$$a_{t+1} = (1 + i_t) a_t + w_t L_t + \Pi_t - P_t^Y C_t \tag{4.7}$$

4.1.4 Capital Creation

I assume that all agents in the model have free access to a constant returns to scale technology that converts output into capital at a ratio of $1 : \kappa_t$. I further assume that this technology is fully reversible.[23] Arbitrage implies that, in period t, κ_t units of capital must have the same market value as 1 unit of output. This pins down the relative price of capital

$$\frac{P_t^K}{P_t^Y} = \kappa_t^{-1} \tag{4.8}$$

4.1.5 Equilibrium

In equilibrium three markets will need to clear: the labor market, the capital market, and the market for consumption goods. The labor market clearing condition equates the household supply of labor with the corporate sector demand for labor. The capital market clearing condition equates the nominal value of household savings a_{t+1} with the nominal value of the corporate sector demand for capital $P_t^K K_{t+1}$. The aggregate resource constraint of the economy, measured in nominal dollars, can be written as

$$P_t^Y Y_t = P_t^Y C_t + P_t^K \left[K_{t+1} - (1 - \delta) K_t\right] \tag{4.9}$$

By Walras's law, the aggregate resource constraint of the economy holds if the labor and capital markets clear and the households are on their budget constraint. An equilibrium[24] is a vector of prices $(i_t^*, w_t^*)_{t \in \mathbb{N}}$ that satisfy the aggregate resource constraint and clear all markets in all periods. Since all firms face the same factor costs and produce using the same technology, in equilibrium[25] they produce the same quantity of output $y_t = Y_t$ and sell this output at the same per-unit price $p_{i,t} = P_t^Y$.

[23] Without this assumption, the relative price of capital is pinned down so long as investment is positive. In the data, investment in each asset is positive in each period. Moreover, the data show no substantial movement in the relative price of capital over the sample period.

[24] Firm optimization requires that firms have beliefs over aggregate output Y_t and house optimization requires that households have beliefs over corporate pure profits Π_t. Equilibrium further requires that firm beliefs and household beliefs hold true.

[25] With a constant returns to scale production technology and the specified market structure there is no indeterminacy in the firm's maximization problem. In more general cases, indeterminacy may arise, in which case there can exist non-symmetric equilibria. With appropriate regularity conditions, it is possible to select an equilibrium by assuming that for a given level of pure profits firms will choose to maximize their size.

4.2 The Roles of Technology, Preferences, Relative Prices, and Markups

Proposition 1. *When markups are fixed, any decline in the labor share must be offset by an equal increase in the capital share.*

Proof. In equilibrium, a marginal allocation plan of labor across firms $\{dl_{i,t}\}_i$ increases aggregate output by $\int_0^1 \mu_t \frac{w_t}{P_t^Y} dl_{i,t} di = \mu_t \frac{w_t}{P_t^Y} \int_0^1 dl_{i,t} di$. Since the aggregate output response to a marginal allocation plan depends only on the aggregate increase in labor $\left(dL_t = \int_0^1 dl_{i,t} di \right)$, we have a well-defined notion of the aggregate marginal productivity of labor that is equal to $\frac{\partial Y_t}{\partial L_t} = \mu_t \frac{w_t}{P_t^Y}$. Similarly, for any marginal allocation plan of capital across firms we have $\frac{\partial Y_t}{\partial K_t} = \mu_t R_t \frac{P_{t-1}^K}{P_t^Y}$. Rearranging these equations we have the following expressions for the labor and capital shares of gross value added

$$S_t^L = \mu_t^{-1} \times \frac{\partial \log Y_t}{\partial \log L_t} \tag{4.10}$$

$$S_t^K = \mu_t^{-1} \times \frac{\partial \log Y_t}{\partial \log K_t} \tag{4.11}$$

Summing across the shares of labor and capital we have

$$S_t^K + S_t^L = \mu_t^{-1} \times \underbrace{\left(\frac{\partial \log Y_t}{\partial \log L_t} + \frac{\partial \log Y_t}{\partial \log K_t} \right)}_{\text{scale of production=1}} \tag{4.12}$$

The combined shares of labor and capital are a function of markups alone. Thus, holding markups fixed, any decline in the labor share must be offset by an equal increase in the capital share. □

The proof of the proposition relies on firm optimization. The proposition holds in equilibrium, not just in steady state. The proof of the proposition is under an assumption of constant returns to scale; more generally, if production is homogeneous of degree γ then the combined shares of labor and capital are equal to $S_t^K + S_t^L = \mu_t^{-1} \times \gamma$.

No assumptions of household behavior, firm ownership, or the functional form of the production function are needed. The degree of generality of this proposition allows us to evaluate several alternative explanations for the decline in the labor share. In all of the following cases, the capital share needs to adjust to perfectly offset the decline in the labor share. Since the data show a decline in the capital share, these explanations alone are unable to match the data.

1. **TFP.** Consider the production function

$$f_t(k, l) = A_t f(k, l)$$

where f is homogeneous of degree 1 (or any other constant degree) in capital and labor. A decline in productivity A_t or a decline in the growth rate of productivity does not affect the combined shares of labor and capital.

2. **Capital Biased Technological Change.** Consider the production function

$$f_t(k,l) = \left(\alpha_K \left(A_{K,t}k\right)^{\frac{\sigma-1}{\sigma}} + (1-\alpha_K)\left(A_{L,t}l\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

Biased technological change, which can be measured as a change to the ratio $\frac{A_{K,t}}{A_{L,t}}$, can cause firms to shift from one input to the other, but does not affect the combined shares of labor and capital.

3. **Relative Prices.** A decline in the price of capital, whether due to improvements in the technology of capital creating or due to an increase in the supply of capital, reduces the price of capital relative to labor. With appropriate assumptions on the elasticity of substitution between labor and capital, the decline in the relative price of capital can cause the labor share to decline, but does not affect the combined shares of labor and capital.

Many other explanations can fit into this simple framework, including changes in the supply of labor and heterogeneous labor and capital inputs. With appropriate assumptions, each of these alternative explanations can cause a decline in the labor share, but does not effect the combined shares of labor and capital.[26] In this sense, a decline in competition, which is measured as a decline in ε and results in the increase in markups, is necessary to match a simultaneous decline in the shares of labor and capital.

4.3 Model-Based Counterfactual and Welfare

In this subsection I calibrate the model to the U.S. non-financial corporate sector. I show that a simultaneous decline in the real interest rate and decline in competition can quantitatively match the decline in the shares of both labor and capital. In addition, I calculate the gaps in output, investment, and wages due to the decline in competition inferred from the data. Across a range of parameter values, the model finds that the decline in competition, which is measured as a decline in ε and results in the increase in markups, leads to large gaps in output (8.3% to 10%), wages (18.9% to 19.5%), and investment (14.1% to 19.8%).

[26] We can separate the firm's optimization problem into cost minimization and pure profit maximization. The first-order condition of cost minimization equates the labor share of costs to the elasticity of output to labor. The alternative explanations discussed above share a common prediction: the decline in the labor share of value added perfectly tracks a decline in the labor share of costs. In the data, the capital share is declining faster than the labor share and as a consequence the labor share of costs is increasing.

4.3.1 Functional Form Specifications

I assume that firms produce using a CES production function

$$y_{i,t} = \left(\alpha_K \left(A_{K,t} k_{i,t}\right)^{\frac{\sigma-1}{\sigma}} + (1-\alpha_K)\left(A_{L,t} l_{i,t}\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \tag{4.13}$$

where σ is the elasticity of substitution between labor and capital. In equilibrium, aggregate output is a CES aggregate of labor and capital with parameters that are identical to the firm-level production function

$$Y_t = \left(\alpha_K \left(A_{K,t} K_t\right)^{\frac{\sigma-1}{\sigma}} + (1-\alpha_K)\left(A_{L,t} L_t\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \tag{4.14}$$

The first-order conditions of firm optimization are

$$\alpha_K A_{K,t}^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_t}{K_t}\right)^{\frac{1}{\sigma}} = \mu_t R_t \frac{P_{t-1}^K}{P_t^Y} \tag{4.15}$$

$$(1-\alpha_K) A_{L,t}^{\frac{\sigma-1}{\sigma}} \left(\frac{Y_t}{L_t}\right)^{\frac{1}{\sigma}} = \mu_t \frac{w_t}{P_t^Y} \tag{4.16}$$

where $\mu_t = \frac{\varepsilon_t}{\varepsilon_t - 1}$ is the equilibrium markup. I assume that household preferences over consumption $\{C_t\}$ and labor $\{L_t\}$ are represented by the utility function

$$\sum_t \beta^t \left[\log C_t - \gamma \frac{\theta}{\theta+1} L_t^{\frac{\theta+1}{\theta}}\right] \tag{4.17}$$

The intra-temporal first-order condition [MRS] is $\gamma L_t^{\frac{1}{\theta}} = \frac{w_t}{P_t^Y} C_t^{-\eta}$ and the inter-temporal first-order condition of the household [Euler equation] is $1 = \beta\left(1+i_{t+1}\right)\left(1+\frac{P_{t+1}^Y - P_t^Y}{P_t^Y}\right)^{-1}\left(\frac{C_{t+1}}{C_t}\right)^{-\eta}$.

4.3.2 Model Parameter Values

The model has two capital parameters: the relative price of capital, which I normalize to 1, and the depreciation rate, which I match to the average depreciation rate of capital in the BEA data. The model has four production parameters: I consider values of the elasticity of substitution between labor and capital σ between 0.4 and 0.7; I calibrate the remaining three parameters (α_K, A_K, A_L) to match the labor share and the capital to output ratio in 1984 and to equate the level of output across the different specifications of the elasticity of substitution. The model has three preference parameters: I calibrate the rate of time preference

β to match the real interest rate; I set the Frisch elasticity of labor supply θ to 0.5;[27,28] and I normalize the disutility of labor parameter γ to equate the steady-state supply of labor across the different specifications.

4.3.3 Forcing Variables

The equilibrium conditions of the model imply that the cost share of gross value added is equal to the inverse of the markup $\mu_t^{-1} = \frac{w_t L_t + R_t P_{t-1}^K K_t}{P_t^Y Y_t}$. I vary competition (measured as the elasticity of substitution between goods) in order to match an increase in markups from 2.5% in 1984 to 21% in 2014. I assume that at the start of the sample the economy is in a steady state with a markup of 2.5% $\left(\varepsilon = \frac{1.025}{1.025-1}\right)$ and at the end of the sample the economy is in a steady state with a markup of 21% $\left(\varepsilon = \frac{1.21}{1.21-1}\right)$. I vary the rate of time preference in order to match the observed change in the real interest rate. I assume that at the start of the sample the economy is in a steady state with a real interest rate of 8.5% $\left(\beta = 1.085^{-1}\right)$ and at the end of the sample the economy is in a steady state with a real interest rate of 1.25% $\left(\beta = 1.0125^{-1}\right)$.

4.3.4 Results

This subsection presents two sets of model-based counterfactual estimates. The first set of model-based counterfactual estimates, which appear in rows 1–3 of Table 4, are backward-looking: they ask how the labor share, capital share, and investment rate should have evolved from 1984 to 2014 in response to a decline in competition (the elasticity of substitution between goods) and a decline in the real interest rate. The second set of model-based counterfactual estimates are forward-looking: they ask how output, wages, and investment can be expected to evolve from 2014 onward if competition increases to its 1984 level, but at the same time interest rates remained low. I report all comparative statics for a range of values of the elasticity of substitution between labor and capital σ between 0.4 and 0.7.

Rows 1–3 of Table 4 present the percentage changes in the labor share, the capital share, and the ratio of investment to output across steady state – all in response to the decline in competition and the decline in the real interest rate. In this counterfactual exercise I vary the degree of competition (the elasticity of substitution between goods) in order to match an increase in markups from 2.5% to 21% and I vary the rate of time preference in order to match the observed change in the real interest rate from 8.5% to 1.25%.

[27] This value is consistent with both micro and macro estimates of the Frisch elasticity of labor supply. See Shimer (2010) and Chetty (2012) for a discussion of micro and macro estimates of the Frisch elasticity.

[28] In unreported results, I consider values of the Frisch elasticity of labor supply θ between 0.5 and 4. Given the preference and technology specifications of the model, the value of the Frisch elasticity affects the level of output, capital, labor, pure profits, and investment, but does not affect the shares of labor, capital, pure profits, or investment. As a consequence, the choice of Frisch elasticity does not affect the shock to competition needed to match this increase in markups, nor does the choice of Frisch elasticity affect the ability of the shock to match the decline in the shares of labor and capital. The choice of Frisch elasticity does have consequences for the gaps in output and investment: the gaps in output and investment are increasing in the value of the Frisch elasticity. In this sense, Table 4 reports lower bounds on the gaps in output and investment. Results based on alternative values of the Frisch elasticity are available from the author upon request.

The model successfully matches the empirically measured declines in the shares of both labor and capital. Across the range of values of the elasticity of substitution between labor and capital the model predicts a decline in the labor share ranging from 9.5% to 12.2% and a decline in the capital share ranging from 23% to 31%. In the data, the labor share declines by 10.3%. In the main specification considered in Section 3 the capital share declines 24.9% and across all empirical specifications the capital share declines between 20.3% and 35.2%. The model over-predicts the change in the investment rate: compared to the observed increase in investment of 7%, the model predicts an increase that ranges from 14.2% to 26.2%.

In this first exercise, competition varies in order to match the change in the share of pure profits. Thus, the counterfactual exercise relies on the measurement of capital costs of Section 3. Since the shares of labor, capital, and pure profits sum to one, by matching the change in the share of pure profits the model will perfectly match the change in combined shares of labor and capital. At the same time, the shares of labor and capital are free to individually vary: a 15 percentage point increase in the share of pure profits is consistent with both (a) a 20 percentage point decline in the share of labor and a 5 percentage point increase in the share of capital, and (b) a 7.5 percentage point decline in the share of labor and a 7.5 percentage point decline in the share of capital. In this sense the model is successful in matching a free moment of the data.

An alternative exercise can help explain the free moment that the model is able to match. Fix the elasticity of substitution between labor and capital at 0.5 (this matches column 2 of Table 4). We can calibrate the change in competition to match the change in the labor share. This alternative exercise does not require data on capital costs or pure profits; instead it assumes that the decline in the labor share is the result of a decline in competition. In order to match a decline in the labor share of 10.4%, in addition to the decline in the real interest rate, the economy would need to move from the 1984 steady state with a markup of 2.5% $\left(\varepsilon = \frac{1.025}{1.025-1}\right)$ to a steady state with a markup of 21% $\left(\varepsilon = \frac{1.21}{1.21-1}\right)$. Without using any data on pure profits or capital to discipline the model, the model predicts that this decline in competition will be accompanied by a 28.2% decline in the capital share.

Rows 4–6 of Table 4 present the gap in output, wages, and investment that are due to the decline in competition. In this counterfactual exercise I vary competition (the elasticity of substitution between goods) in order to decrease markups from 21% back down to 2.5% while holding the rate of time preference constant to match the steady state real interest rate of 1.25%. I refer to the steady state of the economy with a 2.5% markup and 1.25% real interest rate as the potential steady state. For a variable X, I compute the gap in X as $\frac{X-X^*}{X^*}$ where X^* is the value of X in the potential steady state. Across the range of values of the elasticity of substitution between labor and capital the model predicts large gaps in output (8.2% to 10%), wages (18.8% to 19.4%), and investment (14.1% to 19.8%). Said differently, the model predicts large improvements to the economy in response to an increase in competition to its 1984 level: we would see large

increase in output (8.9% to 11.1%), investment (16.4% to 24.7%), and wages (23.2% to 24.1%).

Taken together, this evidence suggests that the decline in competition and increase in markups inferred from the data can explain the bulk of the decline in the shares of both labor and capital and that the decline in the shares of labor and capital is an inefficient outcome.

4.4 Discussion

This section presented a standard general equilibrium model of monopolistic competition and provided three sets of results. First, a decline in competition is necessary to match a joint decline in the shares of labor and capital. While changes to preferences, technology, and relative prices can cause firms to shift from labor to capital, and as a consequence can cause the labor share to decline at the expense of the capital share, these mechanisms cannot cause a simultaneous decline in the shares of both labor and capital. Second, the decline in competition and increase in markups inferred from the data can explain the bulk of the decline in the shares of both labor and capital that we observe in the data from 1984–2014. Last, the model suggests that the decline in competition inferred from the data causes large gaps in output, wages, and investment.

The contribution of a decline in competition to the decline in the labor share depends crucially on our measurement of the capital share. To understand this point it is worth considering three different measurements of the capital share:

1. **Increasing Capital Share.** Consider the case in which the labor share is declining and the capital share increases to fully offset the decline in the labor share. In this case, the model will attribute all of the decline in the labor share to changes in preferences, technology, and relative prices and will attribute none of the decline in the labor share to a decline in competition.[29] If we indirectly infer the capital share as 1 minus the labor share then we are necessarily attributing the decline in the labor share to preferences, technology, and relative prices.

2. **Flat Capital Share.** Consider the case in which the labor share is declining, the capital share does not change, and the pure profit share increases and offsets the decline in the labor share. In this case, the model will attribute part of the decline in the labor share to changes in preferences, technology, and relative prices and will attribute part of the decline in the labor share to a decline in competition. Changes in preferences, technology, and relative prices alone would have caused the capital share to increase; changes in competition alone would have caused the capital share to decline. If we were to measure the capital share under the assumption of a constant required rate of return then we would

[29] Further data and modeling assumptions are needed to quantify the separate contributions of preferences, technology, and relative prices.

find that the capital share has remained flat and we would conclude that preferences, technology, and relative prices and competition both contributed substantially to the decline in the labor share. As discussed in Section 3.7.1, this is precisely the measurement assumption of Karabarbounis and Neiman (2014) and Rognlie (2015). Indeed, based on this measurement assumption Karabarbounis and Neiman (2014) attribute half the decline in the labor share to changes in relative prices and half to an increase in markups.[30]

3. **Declining Capital Share.** Consider the case in which the labor share is declining, the capital share is declining, and the pure profit share is increasing and offsets the decline in the shares of both labor and capital. In this case, the model will attribute much of the decline to a decline in competition. A precise calibration of the model is needed to determine just how much of the decline in the labor share is due to a decline in competition; the range of calibrations that I considered attribute the bulk of the decline to the decline in competition.

The magnitude of the decline in the capital share is of central importance for understanding why the labor share has declined. Existing research has already documented an increase in the share of pure profits. In addition to the work of Karabarbounis and Neiman (2014) and Rognlie (2015), Hall (2016) documents a growing wedge between the return to capital and the risk-free real interest rate, suggestive of an increase in pure profits. An increase in the share of pure profits is not sufficient to determine the cause of the decline in the share of labor; we need a direct measurement of the pure profit share. Measuring the capital share and using market prices of debt and equity to determine the required rate of return lead us to conclude that (1) the capital share declined (2) a decline in competition inferred from the data can explain the bulk of the decline in the shares of both labor and capital that we observe in the data from 1984–2014 (3) the decline in the labor share is accompanied by increasing gaps in output, wages, and investment.

5 Labor Share and Industry Concentration

In this section I provide reduced-form empirical evidence to support the hypothesis that a decline in competition plays a significant role in the decline in the labor share. In the data I am unable to directly measure competition and markups. Instead, I assume that an increase in concentration captures declines in competition and increases in markups. This assumption is true in standard models of imperfect competition and is supported by Salinger (1990) and Rotemberg and Woodford (1991). Using cross-sectional variation I show

[30] Table 4 of Karabarbounis and Neiman (2014) presents a specification in which markups increase and relative prices remain constant. In this specification, the shares of both labor and capital decrease. Based on their measurement of the capital share – which assumes a constant required rate of return and finds that the capital share is flat – they conclude that an increase in markups alone is a poor fit for the data.

that those industries that experience larger increases in concentration also experience larger declines in the labor share. Univariate regressions suggest that the increase in industry concentration can account for most of the decline in the labor share.

5.1 Data

I use census data on industry payrolls, sales, and concentration. Payroll includes all wages and salaries in cash and in kind, as well as all supplements to wages and salaries. The data provide four measures of industry concentrations, namely, the share of sales by the 4, 8, 20, and 50 largest firms. The data are available for the years 1997, 2002, 2007, and 2012 and cover all sectors of the private economy, with the exceptions of agriculture, mining, construction, management of companies, and public administration.

In order to construct changes in the labor share and concentration, I match industries across census years.[31] I construct a sample of all industries that are consistently defined over time and that have data on sales, payroll, and at least one measure of concentration. In several sectors, the census separately reports data for tax-exempt firms and it is not possible to construct an industry measure of concentration. Instead, I consider only firms subject to federal income tax. The results are robust to dropping these sectors. In total, the sample consists of 750 six-digit NAICS industries. As a share of the sectors covered by the census, the matched sample covers 76% of sales receipts in 1997 and 86% of sales receipts in 2012. As a share of the U.S. private economy,[32] the matched sample covers 66% of sales receipts in 1997 and 76% of sales receipts in 2012.

The assignment of firms to industries often includes a large amount of measurement error. When firms operate in multiple industries, the assignment of the firm to any one industry leads to measurement error in the sales, payroll and concentration of all of the industries in which the firm operates. It is therefore difficult to compute industry level outcomes in firm-level datasets such as Compustat. Unlike firm-level datasets, the census does not assign each firm to a single industry. Instead, the census separately assigns each and every establishment to a potentially separate industry. As an example: based on its 10k filing, Compustat assigns Apple to the manufacturing industry Electronic Computers (SIC code 3571) despite the fact that Apple doesn't own or operate a single U.S. manufacturing establishment.[33] By contrast, the census separately assigns Apple's offices, retail stores, and data centers to their own industry. By classifying establishments,

[31] There have been minor revisions the NAICS industry classification in every census since 1997. I map NAICS industries across the censuses using the census-provided concordances, which are available at https://www.census.gov/eos/www/naics/concordances/concordances.html

[32] The data on sales and payroll for the U.S. private economy are taken from Statistics of U.S. Businesses. All U.S. business establishments with paid employees are included in the Statistics of U.S. Businesses reports and tables. All NAICS industries are covered, except crop and animal production; rail transportation; National Postal Service; pension, health, welfare, and vacation funds; trusts, estates, and agency accounts; private households; and public administration. Most government establishments are excluded.

[33] The only Apple-owned manufacturing facility is in Cork, Ireland.

rather than firms, the census reduces measurement error of industry variables.

Table 5 provides descriptive statistics of the labor share (the payroll share of sales) and the four census measures of industry concentration for the matched sample. The labor share of sales declines on average by 1.19 percentage points, or 10%. The sales share of the 4 largest firms increases on average by 5.28 percentage points, or 21%. Almost all of the increase in the share of the 50 largest firms is due to the increase of the 4 largest firms: the shares of the largest 4, 8, 20 and 50 firms all show similar increases when measured in percentage points. Since the share of the 50 largest firms in 1997 is more than double that of the 4 largest firms, the percentage increase in the share of the 50 largest firms is less than half of the percentage increase in the share of the 4 largest firms.

5.2 Empirical Specification

I consider two reduced-form empirical specifications that relate the increase in concentration to the decline in the labor share.[34] The first empirical specification is a regression in first differences

$$S^L_{j,t} - S^L_{j,t-5} = \alpha_t + \beta \left(C^{(n)}_{j,t} - C^{(n)}_{j,t-5} \right) + \varepsilon_{j,t} \tag{5.1}$$

where $S^L_{j,t} - S^L_{j,t-5}$ is the change in the labor share of sales in industry j from year $t-5$ to year t, and $C^{(n)}_{j,t} - C^{(n)}_{j,t-5}$ is the change in the concentration of sales in industry j from year $t-k$ to year t, measured as the change in the share of sales by the 4, 8, 20, and 50 largest firms. The second empirical specification is a regression in log differences

$$\log S^L_{j,t} - \log S^L_{j,t-5} = \alpha_t + \beta \left(\log C^{(n)}_{j,t} - \log C^{(n)}_{j,t-5} \right) + \varepsilon_{j,t} \tag{5.2}$$

In both specifications, I weight each observation by its share of sales in year t and standard errors are clustered by 3-digit NAICS industry.

In order to provide a sense of the magnitude of the decline in the labor share that is predicted by the increase in concentration, I report the observed and predicted decline in the labor share. In the first difference specification, the observed decline is the sales-weighted average change in the labor share $\sum_j w_{j,2012} \left(S^L_{j,2012} - S^L_{j,1997} \right)$, where $w_{j,t} = \frac{\text{sales}_{j,t}}{\sum_j \text{sales}_{j,t}}$ is industry j's share of sales in year t and $S^L_{j,t} = \frac{\text{payroll}_{j,t}}{\text{sales}_{j,t}}$ is the labor share of sales in industry j in year t. Note that this is the within-industry decline in the labor

[34] A previous version of this paper reported results of regressions of changes in the labor share on changes in industry concentration using a single cross section (changes from 1997 to 2012). There was a mistake in the calculation of standard errors: once the standard errors were corrected, several of the regression coefficients were statistically insignificant. To increase power, I now use all of the 5-year changes in the labor share and concentration. As reported in the previous version, the estimated coefficients are similar across the two specifications. Therefore, the results and their interpretation remain the same. I want to thank Tony Fan and Austan Goolsbee for pointing out the error.

share in the standard variance decomposition.[35] The predicted decline is the sales-weighted average predicted change in the labor share, namely, $\sum_j w_{j,2012}\beta\left(C^{(n)}_{j,t} - C^{(n)}_{j,t-5}\right)$. In the log-difference specification, the observed decline is the sales-weighted average change in the log-labor share and the predicted decline is the sales-weighted average predicted change in the log-labor share.

5.3 Results

Table 6 presents the results of regressions of the change in the labor share on the change in industry concentration, as specified in Equation 5.1. Columns 1–4 show the results of weighted regressions of the change in the labor share on the change in industry concentration, measured as the share of sales by the 4, 8, 20, and 50 largest firms. The table shows that those industries that experience larger increases in concentration of sales also experience larger declines in the labor share. The slope coefficient is negative and statistically significant in each of the regressions. Based on the estimated coefficient and observed increase in the concentration, the predicted decline in the labor is similar in magnitude to observed decline in the labor share. The slope coefficient remains stable across the specifications – this is expected since almost all of the increase in the share of the 50 largest firms is due to the increase of the 4 largest firms. Table 7 presents the results of the log specification. The slope coefficient is negative and statistically significant in each of the regressions. In this specification, the predicted decline is between 33% and 40% of the observed decline in the log-labor share. In the log specification the slope coefficient is increasing in absolute value across the specifications: the percentage increase in the share of the 50 largest firms is less than half of the percentage increase in the share of the 4 largest firms and the slope coefficient of the 50 largest firms is close to double that of the 4 largest firms. Taken together, the results suggest that the increase in concentration can account for most of decline in the labor share.

5.4 Robustness

The census data do not properly capture foreign competition and likely overestimate concentration in product markets for tradable goods. To the extent that foreign competition has increased over time, the census data likely overestimate increases in concentration in product markets for tradable goods. To address this concern I repeat the analysis excluding all tradable industries.[36] I find that excluding tradable industries does not alter the results. Furthermore, in the sample of tradable industries there is only a very small cross sectional

[35] The decline in the labor share is the sum of the between-industry decline and the within-industry decline $S^L_{2012} - S^L_{1997} = \sum_j (w_{j,2012} - w_{j,1997}) S^L_{j,1997} + \sum_j w_{j,2012}\left(S^L_{j,2012} - S^L_{j,1997}\right)$. In the data, The within-industry term accounts for 72% of the aggregate decline in the labor share of sales. A similar decomposition of industry concentration finds that the entire increase in industry concentration is due to the increase in the within-industry component.

[36] I use the industry classification provided by Mian and Sufi (2014).

relationship between changes in measured concentration and changes in the labor share. In the sample of tradable industries, the regressions predict almost no decline in the labor share. These results are reported in columns 2 and 3 of Table 8.

Second, in several sectors the census measures concentration separately for tax-exempt firms. This introduces measurement error in the concentration variable. Column 4 of Table 8 repeats the analysis after excluding sectors in which tax-exempt firms make up a large fraction of sales (health care and social assistance, and other services). I find that excluding these sectors does not alter the results.

Last, an increase in the importance of intangible capital could cause a decline in the labor share and an increase in concentration that is unrelated to decline in competition. Column 5 of Table 8 repeats the analysis after excluding R&D intensive industries.[37] I find that excluding these industries does not alter the results.

5.5 Discussion

The results of this section show that the decline in the labor share is strongly associated with an increase in concentration. This is consistent with the hypothesis that a decline in competition plays a significant role in the decline in the labor share. Unlike the aggregate results of Section 3, the results of this section do not rely on capital data and are not subject to concerns about the measurement of capital. Using alternative sources of data and variation, this section complements the aggregate findings.

The aggregate results of Section 3 and the industry results of this section are consistent with several price-setting mechanisms. First, the results are consistent with a model in which firms face barriers to entry, and prices are the result of Cournot competition. An increase in barriers to entry results in higher concentration driven by a decline in the number of firms, higher markups driven by an increase in prices, and a decline in the labor share. This model predicts a within-firm decline in the labor share and no correlation between changes in the labor share and changes in productivity.

The results are also consistent with a model of a dominant firm and a competitive fringe, where prices are equal to the marginal cost of the firms in the competitive fringe. In such a model, an increase in the productivity of the dominant firm also results in higher concentration driven by the growth of the dominant firm, higher markups driven by a decline in production costs of the dominant firm, and a decline in the labor share. This model predicts a decline in the labor share that is mostly due to a reallocation across firms that is positively correlated with changes in productivity.

[37] Data on R&D by industry are taken from the NSF R&D survey. I exclude Chemical Manufacturing (NAICS 325), Computer and Electronic Product Manufacturing (NAICS 334), Transportation Equipment Manufacturing (NAICS 336), Software Publishers (NAICS 5112), Computer Systems Design and Related Services (NAICS 5415), and Scientific R&D Services (NAICS 5417).

Hartman-Glaser, Lustig and Zhang (2016) and Autor et al. (2017) provide evidence that reallocation across firms has contributed to the decline in the labor share. The authors offer explanations for the decline in the labor share that focus on productivity (Autor et al. (2017)) and insurance and intangible capital (Hartman-Glaser, Lustig and Zhang (2016)). These explanations, on their own, predict an equally sized correlation between increased concentration and declining labor share in both tradable and non-tradable industries – the data show almost no correlation in tradable industries. These explanations could be consistent with industry data if they lead to a reallocation of resources toward firms that charge higher markups. Moreover, a reallocation of resources toward firms that charge higher markups is necessary to match the aggregate decline in the capital share and increase in the pure profit share.

6 Discussion of Alternative Explanations

This paper argues and provides evidence that a decline in competition plays a significant role in the decline in the labor share. This section discusses five alternative explanations for the decline in the labor share: tradeoffs between labor and physical capital, omitted intangible capital, adjustment costs, an unmeasured increase in the equity risk premium, and a rise in monopsony power.

Labor vs Physical Capital Many existing explanations for the decline in the labor share focus on tradeoffs between labor and physical capital. If these explanations were true, we should have seen a large investment boom over the period 1984–2014 for two reasons. First, the process of replacing labor with physical capital should have required a large increase in investment. Second, the large decline in the cost of financing physical capital should have led firms to greatly increase their use of these inputs. The data do not show any evidence of an investment boom.

The results of Section 3 show that in 1984 every dollar of labor costs was accompanied by approximately 49¢ of capital costs. By 2014, a dollar of labor costs was accompanied by only 41¢ of capital costs. These estimates of capital costs include the forms of intangible capital measured by the BEA (intellectual property products). Since 1984, capital costs for all forms of physical capital have been growing at a slower rate than the capital costs for all forms of intangible capital measured by the BEA. . Thus, despite the decline in the labor share, labor costs have increased faster than total capital costs and total capital costs have increased faster than physical capital costs.

Omitted Intangible Capital In Section 3.5.4, I take two approaches to assessing the contribution of omitted intangible capital to the measured increase in pure profits. First, I incorporate the most compre-

hensive existing measures of omitted intangible capital into the analysis. I find that existing measures of intangible capital are unable to explain the rise in pure profits. Second, I construct a large number of scenarios for omitted intangible capital. There are scenarios that can account for most of the increase in pure profits, but in all such scenarios the value of missing intangible capital in 2014 would need to be larger than all capital measured by the BEA.

An increase in the importance of omitted intangible capital and a rise in pure profits are not mutually exclusive.

From an accounting perspective, many of the scenarios of omitted intangible capital that I consider feature a simultaneous increase in intangible capital as well as a large increase in pure profits. In this sense, the measured rise in pure profits is consistent with many scenarios that feature rapidly increasing intangible capital.

From an economic perspective, it may well be the case that intangible investment (e.g. advertising and branding) affects consumer demand and allows firms to charge higher markups. For example, we might model intangible investment in the demand equation

$$D\left(p_i\right) = Y\left(\frac{p_i}{P^Y}\right)^{f(\text{intangible})} \tag{6.1}$$

If intangible capital affects consumer demand, a rise in intangible capital could potentially account for the rise in markups and pure profits.

At the same time, if we accept the empirical analysis of Section 3.5.4 and if based on the analysis we conclude that there are pure profits in excess of intangible capital costs, then we would not be able to reconcile these empirical results with a model of intangible investment and free entry. Without free entry, investments that decrease competition and increase markups can earn more than their competitive cost of creation. With free entry, investments that decrease competition and increase markups can only push pure profits to the point where they cover the cost of investment.

Adjustment Costs A common approach to measuring adjustment costs combines parametric assumptions on the functional form of adjustment costs and data on the ratio of investment to capital. To the extent that this approach correctly captures adjustment costs, the data show that the ratio of investment to capital is in fact slightly declining over the sample period. This suggest that adjustment costs have gone down and the trend of pure profits in excess of adjustment costs is understated.

Another approach to assessing the potential contribution of adjustment costs is to consider model-based results. Using a model, we can ask two different questions. First, for a given calibration of the model, can

slow responses on the part of firms explain the observed trends in the data? Second, can a change in the severity of adjustment costs explain the observed trends in the data?

In Appendix B I incorporate quadratic adjustment costs into a baseline model of monopolistic competition. In the model, firms own the capital stock and choose a path of investment that maximizes their market value. In the model, I mimic the empirical measurement of capital costs and pure profits. I calculate capital costs as $(r + \delta) \times K$ and I calculate pure profits as gross operating surplus less capital costs.

For a wide range of adjustment cost parameters,[38] I compute the unconditional means and standard deviations of the labor, capital, and pure profit shares. I find that these unconditional means are insensitive to the adjustment cost parameter. In this sense, a change to the adjustment cost parameter should not result in a change to the long-run level of the labor share or pure profit share.

In addition, for different values of the adjustment cost parameter I compute the pairwise correlations of the labor, capital, and pure profit shares. For any positive adjustment cost parameter, the labor and pure profit shares are procyclical and positively correlated. Models with higher values of the adjustment cost parameter feature higher correlations between the labor and pure profit shares. These results suggest that a path of shocks that lead to higher measured pure profits should also lead to a higher labor share.

Increase in the Equity Risk Premium The measurement of the capital share in this paper builds on the work of Karabarbounis and Neiman (2014) and Rognlie (2015). The point of departure of this paper from the past work is the use of market prices to measure debt and equity costs of capital. As described in Section 3.7.1, measures of the capital share that assume a constant required rate of return show no decline, while measures of the capital share that incorporate market prices show a large decline.

Unlike the debt cost of capital and other inputs into the required rate of return, the equity cost of capital is unobserved and requires a model. Throughout the paper, I approximate the equity cost of capital as the sum of the yield on the ten-year U.S. treasury bond and a 5% equity risk premium. Typical constructions of the equity cost of capital measure an equity risk premium relative to the yield on a one-year treasury bill. An equity risk premium of 5% relative to a 10-year treasury bond implies an average risk premium of 6.5% relative to the one-year treasury bill that has increased since 2008 to 7.4%.

If in fact the equity premium has increased, then my construction will overstate the trend decline in the required rate of return and the trend increase in pure profits. There are three ways to assess the validity of the measured pure profits. First, we can compare the equity cost of capital used in this paper to model-based estimates. Second, we can compare the measured increase in pure profits to alternative measures that do not rely on estimating the equity cost of capital. Third, we can back out a path of an equity risk premium

[38] This range includes implausibly high values of adjustment costs. See Tobin (1981) and Hall (2001) for further details.

that can fully account for the measured increase in pure profits.

1. Appendix A presents the equity cost of capital implied by each of the 20 models considered by Duarte and Rosa (2015). The appendix shows that the sum of the yield on the ten-year U.S. treasury and a 5% equity risk premium provides a good approximation to both the level and trend of many models of the equity cost of capital. At the same time, there are models that imply a large increase in the equity risk premium. The models that imply a large increase in the equity risk premium also predict negative expected returns on the market. If we exclude models that predict negative expected returns on the market, then the remaining models feature a stable or declining equity risk premium.[39]

2. In Section 3.6 I present a measure of aggregate pure profits that are derived from aggregate market valuations. The implementation of this approach to measuring capital costs and pure profits only requires data on market values of debt and equity and the nominal value of capital. The market-valuation implied pure profit share is very similar in trend and level to the flow measures of the pure profit share presented in the main specification.

As described in Section 3.7.2, De Loecker and Eeckhout (2017) provide production-based estimates of markups for non-financial U.S. public firms. Unlike my estimates of pure profits, the production-based estimates of markups do not impute capital costs, nor do they rely on time-series variation in capital or on assumptions on the required rate of return on capital and its components. Consistent with the findings in this paper, De Loecker and Eeckhout (2017) find a large increase in markups since the 1980s. Similarly, Hall (2018) constructs industry-level markups and similarly finds a large increase in markups since the late 1980s.

3. We can construct a *break-even equity risk premium*, defined as the equity risk premium that can fully account for the measured increase in pure profits. Specifically, in each year we can numerically calculate an equity cost of capital that would imply zero profits. We can then calculate the break-even equity risk premium as the difference between the implied equity cost of capital and a one-year U.S. treasury bill. Approximating the time series by a linear trend, we see that in order to account for the rise in measured pure profits the equity risk premium would need to increase by 10 percentage points over the period 1984–2014.

Recent work by Caballero, Farhi and Gourinchas (2017) argues that the equity risk premium has increased in the years following the financial crisis. Can a post-crisis rise in the equity risk premium account for the increase in measured pure profits? If so, then we would expect that pure profits are accurately measured pre-crisis and overstated post-crisis. However, the data show that excluding the post-crisis years from the sample leads to an increase in the trend of the pure profit share. In this sense the increase in pure profits is not a feature of the post-crisis period.

[39] There is one model, Model 06, that has only been available since 2003. This model shows a trend increase in the equity risk premium and does not feature a negative expected return on the market. This model is a small variation on (and very closely tracks) other models that feature negative expected returns on the market in earlier periods.

Another way of addressing the potential contribution of the post-crisis period is to ask whether a post-crisis increase in the equity risk premium helps account for measured pure profits. I consider two additional time-series approximations to the break-even equity risk premium (BEERP). First, I measure a trend allowing for a post-2008 level change, $BEERP_t = \alpha + \beta \times t + \gamma I\{\text{post 2008}\} + \varepsilon_t$. Second, I measure a trend allowing for a post-2008 level and trend change, $BEERP_t = \alpha + \beta \times t + \gamma I\{\text{post 2008}\} + \delta \times t \times I\{\text{post 2008}\} + \varepsilon_t$. Positive values of γ and δ would support the hypothesis of a post-crisis increase in the equity risk premium that can help account for measured pure profits. On the contrary, in both specifications I find negative values of γ and δ.

Labor vs Management An alternative explanation for the decline in the labor share focuses on firm monopsony power. Early work in this literature focuses on firm bargaining power.[40] In this view, imperfect product markets generate pure profits and the bargaining power of workers determines the share of pure profits that are given to workers. As the bargaining power of workers decreases, fewer of the pure profits are shared with workers and as a result the measured labor share declines and the measured pure profit share increases.

More recent work in this literature focuses on firms' hiring distortions.[41] In this view, firms can impact wages and they account for this impact on wages when they make hiring decisions. In order to keep wages low, firms in highly concentrated employment markets hire fewer employees and pay lower wages than equally productive firms that are located in less concentrated employment markets. Hiring fewer employees at lower wages generates pure profits.

Monopsony power in labor markets can distort hiring decisions, but should have relatively little impact on investment decisions. In other words, monopsony may help explain a decline in the labor share, but it is unable to explain weak investment in the presence of low financing costs and the resulting decline in the capital share. Unlike monopsony power, monopoly power can simultaneously match the decline in the labor share and the decline in the capital share in a general equilibrium model. Recent empirical evidence suggests that monopsony power helps explain the cross-section of wages. At the same time, existing evidence shows only modest increases over time in the concentration of employment markets. Taken together, the evidence suggests that monopsony power can explain differences in wages across geographic locations and likely plays a modest role in the aggregate time-series decline in the labor share.

[40] See Blanchard and Giavazzi (2003), Bental and Demougin (2010), and Stiglitz (2012).
[41] See Azar, Marinescu and Steinbaum (2017), Azar and Vives (2018), and Benmelech, Bergman and Kim (2018).

7 Conclusion

Labor compensation in the U.S. economy used to track labor productivity. Up until the 1980s, increases in labor productivity were accompanied by equally sized increases in labor compensation. The decline in the labor share since the early 1980s measures the growing gap between labor productivity (which has continued to grow) and compensation (which has stagnated).

The existing literature on the decline in the labor share is focused on tradeoffs between labor and physical capital. It argues that, whether due to technological change, globalization, or a change in relative prices, firms have replaced expenditures on labor inputs into production with expenditures on physical capital inputs into production. The literature further views this shift away from labor toward capital as efficient. By contrast, this paper shows that labor costs have not been replaced by capital costs. Instead, measured as a share of gross value added, since the early 1980s firms have reduced both labor and capital costs and increased pure profits.

This paper takes a direct approach to measuring capital costs and the capital share. Following Hall and Jorgenson (1967), I compute a series of capital costs for the U.S. non-financial corporate sector over the period 1984–2014, equal to the product of the required rate of return on capital and the value of the capital stock. Using this method, past research studied the period leading up to the 1980s and found very small pure profits. While I confirm past estimates of capital costs and pure profits in the early 1980s, I find large and striking changes to the U.S. economy since the early 1980s.

Direct measures of capital costs show that the capital share is declining. Measured in percentage terms, the decline in the capital share (25%) is larger than the decline in the labor share (10%). Thus, despite the decline in the labor share, labor costs have in fact increased faster than capital costs. Offsetting the large declines in the labor and capital shares is a large increase in the pure profit share. While the precise measure of the increase in pure profits varies across specifications, in all specifications the value of this increase in pure profits amounts to over $1.1 trillion in 2014, or $14 thousand per employee (nearly half of median personal income in the U.S.).

This paper draws on a standard general equilibrium model and industry data to argue that the decline in the shares of labor and capital is the result of a decline in competition. The degree of generality of the model allows us to consider a wide range of alternative explanations for the decline in the labor share, including a slowdown in TFP growth, technological change, and a change in the supply of labor. Only a decline in competition can explain a simultaneous decline in the shares of labor and capital. In this sense, a decline in competition is necessary to match the data. A calibrated version of the model shows that a decline in competition quantitatively matches the data. Turning to industry data, I find that increases in industry

concentration are associated with declines in the labor share. Taken as a whole, my results suggest that the decline in the shares of labor and capital are due to a decline in competition and call into question the conclusion that the decline in the labor share is an efficient outcome.

Several recent papers have focused attention on the increase in industry concentration. Gutiérrez and Philippon (2016) show that a lack of competition and firm short-termism explain under-investment. Even after they control for current market conditions, they find that industries with more concentration and more common ownership invest less. The authors also find that those firms that under-invest spend a disproportionate amount of free cash flows buying back their shares. Grullon, Larkin and Michaely (2016) show that firms in industries that are growing more concentrated enjoy higher profit margins, positive abnormal stock returns, and more profitable M&A deals. A decline in the demand for labor inputs (which results in a decline in the labor share) and a simultaneous decline in demand for capital inputs (which results in under-investment) are distinctive traits of declining competition.

This paper is not arguing that technology, automation, and globalization have played no part in the decline in the labor share. It may well be the case that the forces of technological change and globalization favor dominant firms and are causing the decline in competition. The causes of the decline in competition are left as an open question for future research.

References

Acemoglu, Daron. 2003. "Labor- and Capital-Augmenting Technical Change." *Journal of the European Economic Association*, 1(1): 1–37.

Acemoglu, Daron, and Pascual Restrepo. 2016. "The Race Between Machine and Man: Implications of Technology for Growth, Factor Shares and Employment." NBER Working Paper 22252.

Atkeson, Andrew, and Patrick J. Kehoe. 2005. "Modeling and Measuring Organization Capital." *Journal of Political Economy*, 113(5): 1026–1053.

Autor, David, David Dorn, Lawrence F. Katz, Christina Patterson, and John Van Reenen. 2017. "The Fall of the Labor Share and the Rise of Superstar Firms." NBER Working Paper 23396.

Azar, José. 2012. "A New Look at Oligopoly: Implicit Collusion Through Portfolio Diversification." Ph.D. Thesis, Princeton University.

Azar, José, and Xavier Vives. 2018. "Oligopoly, Macroeconomic Performance, and Competition Policy." CEPR Discussion Paper No. 13000.

Azar, José, Ioana Marinescu, and Marshall I. Steinbaum. 2017. "Labor Market Concentration." NBER Working Paper No. 24147.

Azar, José, Martin C. Schmalz, and Isabel Tecu. 2016. "Anti-Competitive Effects of Common Ownership." Ross School of Business Working Paper No. 1235.

Azar, José, Sahil Raina, and Martin C. Schmalz. 2016. "Ultimate Ownership and Bank Competition." University of Michigan Working Paper.

Barkai, Simcha, and Seth G. Benzell. 2018. "70 Years of US Corporate Profits." Stigler Center for the Study of the Economy and the State, New Working Paper Series No. 22.

Basu, Susanto, and John G. Fernald. 1997. "Returns to Scale in US Production: Estimates and Implications." *Journal of Political Economy*, 105(2): 249–283.

Benmelech, Efraim, Nittai Bergman, and Hyunseob Kim. 2018. "Strong Employers and Weak Employees: How Does Employer Concentration Affect Wages?" NBER Working Paper No. 24307.

Bental, Benjamin, and Dominique Demougin. 2010. "Declining Labor Shares and Bargaining Power: An Institutional Explanation." *Journal of Macroeconomics*, 32(1): 443–456.

Berndt, Ernst R., and Melvyn A. Fuss. 1986. "Productivity Measurement with Adjustments for Variations in Capacity Utilization and Other Forms of Temporary Equilibrium." *Journal of Econometrics*, 33(1): 7–29.

Bessen, James E. 2016. "Accounting for Rising Corporate Profits: Intangibles or Regulatory Rents?" Boston University School of Law, Law and Economics Research Paper No. 16–18.

Blanchard, Olivier, and Francesco Giavazzi. 2003. "Macroeconomic Effects of Regulation and Deregulation in Goods and Labor Markets." *Quarterly Journal of Economics*, 118(3): 879–907.

Blonigen, Bruce A., and Justin R. Pierce. 2016. "Evidence for the Effects of Mergers on Market Power and Efficiency." NBER Working Paper 22750.

Brynjolfsson, Erik, and Andrew McAfee. 2014. *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies.* WW Norton & Company.

Caballero, Ricardo J., Emmanuel Farhi, and Pierre-Olivier Gourinchas. 2017. "Rents, Technical Change, and Risk Premia: Accounting for Secular Trends in Interest Rates, Returns on Capital, Earning Yields, and Factor Shares." *American Economic Review*, 107(5): 614–20.

Chetty, Raj. 2012. "Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply." *Econometrica*, 80(3): 969–1018.

Corrado, Carol A., Charles R. Hulten, and Daniel Sichel. 2009. "Intangible Capital and US Economic Growth." *Review of Income and Wealth*, 55(3): 661–685.

Corrado, Carol, Jonathan Haskel, Cecilia Jona-Lasinio, and Massimiliano Iommi. 2016. "Intangible Investment in the EU and US Before and Since the Great Recession and its Contribution to Productivity Growth." EIB Working Papers No. 2016/08.

De Loecker, Jan, and Jan Eeckhout. 2017. "The Rise of Market Power and the Macroeconomic Implications." NBER Working Paper 23687.

Duarte, Fernando, and Carlo Rosa. 2015. "The Equity Risk Premium: A Review of Models." *Economic Policy Review*, 21(2): 39–57.

Eisfeldt, Andrea L., and Dimitris Papanikolaou. 2013. "Organization Capital and the Cross-Section of Expected Returns." *The Journal of Finance*, 68(4): 1365–1406.

Elsby, Michael W.L., Bart Hobijn, and Ayşegül Şahin. 2013. "The Decline of the U.S. Labor Share." *Brookings Papers on Economic Activity*, 2013(2): 1–63.

Fernald, John G., and Charles I. Jones. 2014. "The Future of U.S. Economic Growth." *American Economic Review*, 104(5): 44–49.

Fichtner, Jan, Eelke M. Heemskerk, and Javier Garcia-Bernardo. 2017. "Hidden Power of the Big Three? Passive Index Funds, Re-Concentration of Corporate Ownership, and New Financial Risk." *Business and Politics*, 19(2): 1–29.

Fraumeni, Barbara. 1997. "The Measurement of Depreciation in the US National Income and Product Accounts." *Survey of Current Business*, 77(7): 7–23.

Furman, Jason, and Peter Orszag. 2015. "A Firm-Level Perspective on the Role of Rents in the Rise in Inequality." Presentation at "A Just Society" Centennial Event in Honor of Joseph Stiglitz, Columbia University.

Gilchrist, Simon, and Egon Zakrajsek. 2007. "Investment and the Cost of Capital: New Evidence from the Corporate Bond Market." NBER Working Paper 13174.

Gonzalez, Ignacio, and Pedro Trivın. 2016. "Finance and the Global Decline of the Labour Share."

Grullon, Gustavo, Yelena Larkin, and Roni Michaely. 2016. "Are U.S. Industries Becoming More Concentrated?"

Gutiérrez, Germán, and Thomas Philippon. 2016. "Investment-Less Growth: An Empirical Investigation." NBER Working Paper 22897.

Hall, Robert E. 2001. "The Stock Market and Capital Accumulation." *American Economic Review*, 91(5): 1185–1202.

Hall, Robert E. 2016. "Macroeconomics of Persistent Slumps." In *Handbook of Macroeconomics*. Vol. 2, , ed. John B. Taylor and Harald Uhlig, Chapter 27, 2131–2181. North Holland.

Hall, Robert E. 2018. "New Evidence on the Markup of Prices over Marginal Costs and the Role of Mega-Firms in the US Economy." NBER Working Paper 24574.

Hall, Robert E., and Dale W. Jorgenson. 1967. "Tax Policy and Investment Behavior." *American Economic Review*, 57(3): 391–414.

Hansen, Lars Peter, John C. Heaton, and Nan Li. 2005. "Intangible Risk." In *Measuring Capital in the New Economy.* , ed. Carol Corrado, John Haltiwanger and Daniel Sichel, 111–152. University of Chicago Press.

Hartman-Glaser, Barney, Hanno Lustig, and Mindy X. Zhang. 2016. "National Income Accounting When Firms Insure Managers: Understanding Firm Size and Compensation Inequality." NBER Working Paper 22651.

Hulten, Charles R. 1986. "Productivity Change, Capacity Utilization, and the Sources of Efficiency Growth." *Journal of Econometrics*, 33(1): 31–50.

Hulten, Charles R., and Frank C. Wykoff. 1981. "The Measurement of Economic Depreciation." In *Depreciation, Inflation, and the Taxation of Income from Capital.* , ed. Charles R. Hulten. Urban Institute Press.

Hulten, Charles R., and Xiaohui Hao. 2008. "What is a Company Really Worth? Intangible Capital and the 'Market to Book Value' Puzzle." NBER Working Paper 14548.

Jones, Charles I. 2003. "Growth, Capital Shares, and a New Perspective on Production Functions."

Jorgenson, Dale W., and Kevin J. Stiroh. 2000. "Raising the Speed Limit: U.S. Economic Growth in the Information Age." *Brookings Papers on Economic Activity*, 2000(1): 125–235.

Jorgenson, Dale W., and Kun-Young Yun. 1991. *Tax Reform and the Cost of Capital.* Oxford University Press.

Jorgenson, Dale W., Frank M. Gollop, and Barbara M. Fraumeni. 1987. *Productivity and U.S. Economic Growth.* North-Holland Amsterdam.

Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh. 2005. *Productivity, Volume 3: Information Technology and the American Growth Resurgence.* MIT Press.

Karabarbounis, Loukas, and Brent Neiman. 2014. "The Global Decline of the Labor Share." *Quarterly Journal of Economics*, 129(1): 61–103.

King, Mervyn A., and Don Fullerton. 1984. *The Taxation of Income from Capital.* University of Chicago Press.

Koh, Dongya, Raül Santaeulàlia-Llopis, and Yu Zheng. 2016. "Labor Share Decline and Intellectual Property Products Capital." Washington University St. Louis Working Paper.

Kulick, Robert. 2016. "Horizontal Mergers, Prices, and Productivity." Ph.D. Thesis, University of Maryland.

Lindenberg, Eric B., and Stephen A. Ross. 1981. "Tobin's q Ratio and Industrial Organization." *Journal of Business*, 54(1): 1–32.

McGrattan, Ellen R., and Edward C. Prescott. 2010. "Unmeasured Investment and the Puzzling US Boom in the 1990s." *American Economic Journal: Macroeconomics*, 2(4): 88–123.

Mian, Atif, and Amir Sufi. 2014. "What Explains the 2007–2009 Drop in Employment?" *Econometrica*, 82(6): 2197–2223.

Moody's. 2018. "Annual Default Study: Corporate Default and Recovery Rates, 1920–2017."

Moylan, Carol E. 2008. "Employee Stock Options and the National Economic Accounts." *Survey of Current Business*, 88(2): 7–13.

Peltzman, Sam. 2014. "Industrial Concentration under the Rule of Reason." *Journal of Law and Economics*, 57(S3): S101–S120.

Piketty, Thomas. 2014. *Capital in the Twenty-First Century.* Cambridge, MA: Belknap Press.

Piketty, Thomas, and Gabriel Zucman. 2014. "Capital is Back: Wealth-Income Ratios in Rich Countries 1700–2010." *Quarterly Journal of Economics*, 129(3): 1255–1310.

Rognlie, Matthew. 2015. "Deciphering the Fall and Rise in the Net Capital Share: Accumulation or Scarcity?" *Brookings Papers on Economic Activity*, 2015(1): 1–69.

Rotemberg, Julio J., and Michael Woodford. 1991. "Markups and the Business Cycle." *NBER Macroeconomics Annual*, 6: 63–140.

Rotemberg, Julio J., and Michael Woodford. 1995. "Dynamic General Equilibrium Models with Imperfectly Competitive Product Markets." In *Frontiers of Business Cycle Research.* , ed. Thomas F. Cooley, 243–293. Princeton University Press.

Salinger, Michael. 1984. "Tobin's q, Unionization, and the Concentration-Profits Relationship." *Rand Journal of Economics*, 15(2): 159–170.

Salinger, Michael. 1990. "The Concentration-Margins Relationship Reconsidered." *Brookings Papers on Economic Activity*, 1990(1): 287–335.

Shimer, Robert. 2010. *Labor Markets and Business Cycles.* Princeton University Press.

Smith, Matthew, Danny Yagan, Owen Zidar, and Eric Zwick. 2017. "Capitalists in the 21st Century." University of Chicago Working Paper.

Stiglitz, Joseph E. 2012. *The Price of Inequality: How Today's Divided Society Endangers Our Future.* WW Norton & Company.

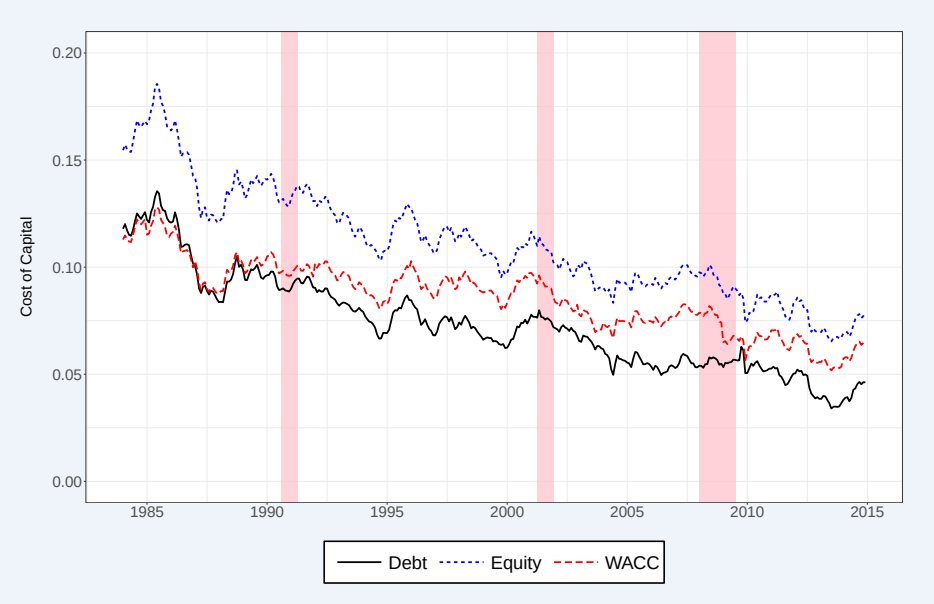
Summers, Lawrence H. 2013. "Economic Possibilities for our Children." NBER Reporter.

Tobin, James. 1981. "Discussion of Summers." *Brookings Papers on Economic Activity*, 1981(1): 132–9.

Zeira, Joseph. 1998. "Workers, Machines, and Economic Growth." *Quarterly Journal of Economics*, 113(4): 1091–1117.

Figure 1: **The Required Rate of Return on Capital**
The figure shows the components of the required rate of return on capital for the U.S. non-financial corporate sector over the period 1984–2014. Panel A: the debt cost of capital is set to the yield on Moody's Aaa bond portfolio and the equity cost of capital is set to the sum of the risk-free rate (yield on the ten-year treasury) and the equity risk premium (5%). Panel B: expected capital inflation is calculated as a three-year moving average of realized capital inflation and expected consumption inflation is the median expected 12-month price change from the University of Michigan's Survey of Consumers. Panel C: the depreciation rate of capital is taken from the BEA Fixed Asset Tables. Panel D: the required rate of return on capital is calculated as $\left(\left(\frac{D}{D+E}i^D\left(1-\tau\right)+\frac{E}{D+E}i^E\right)-\mathbb{E}\left[\pi\right]+\delta\right)\frac{1-z\times\tau}{1-\tau}$; the figure includes a fitted linear trend. See Section 3 for further details.

(a) Cost of Capital



(b) Expected Inflation

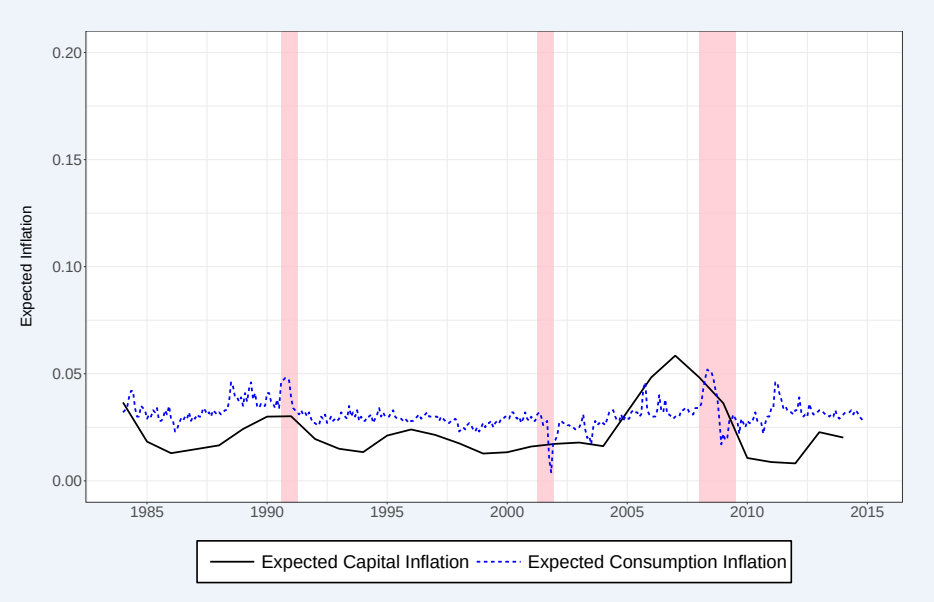
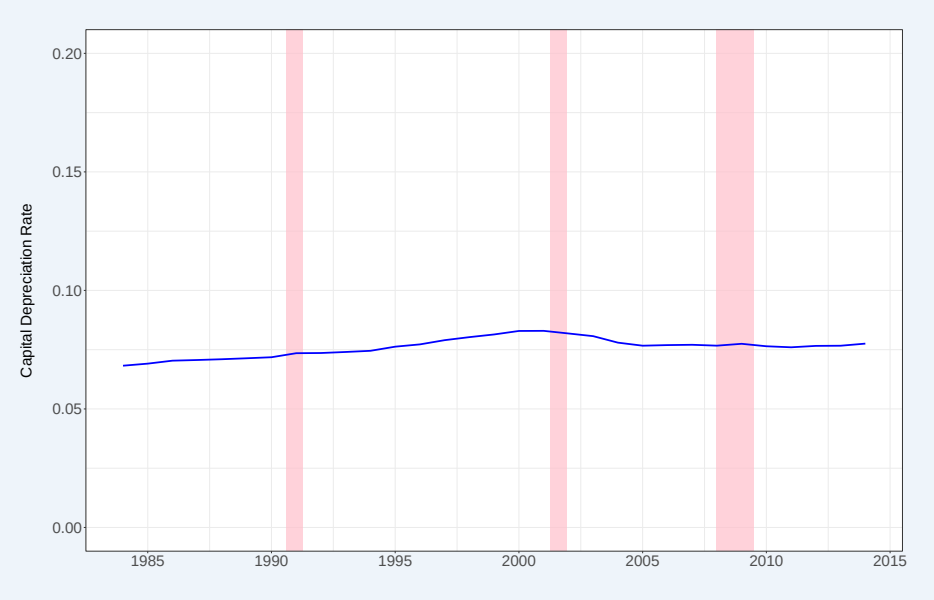


Figure 1: **The Required Rate of Return on Capital** (continued from previous page)

(c) Depreciation Rate



(d) Required Rate of Return

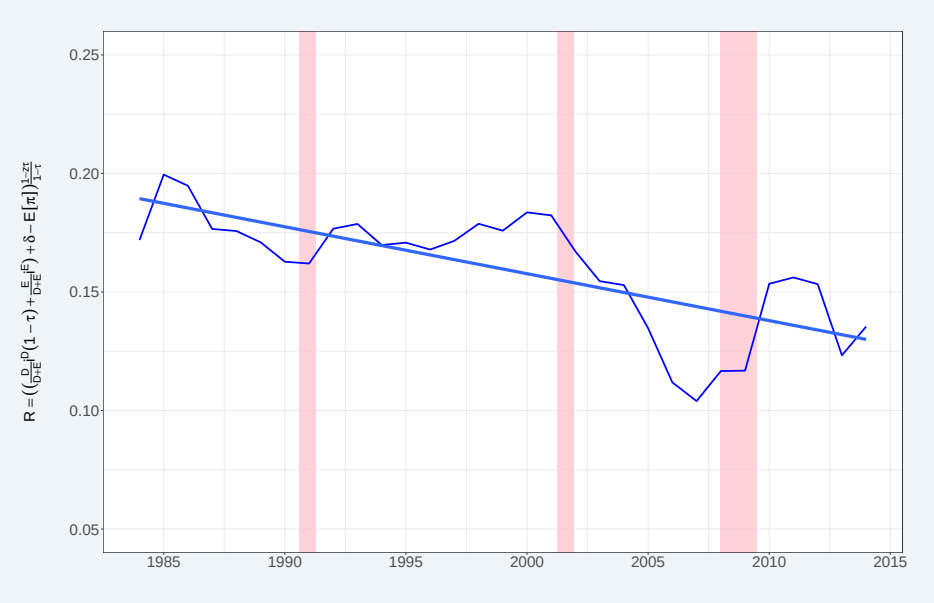
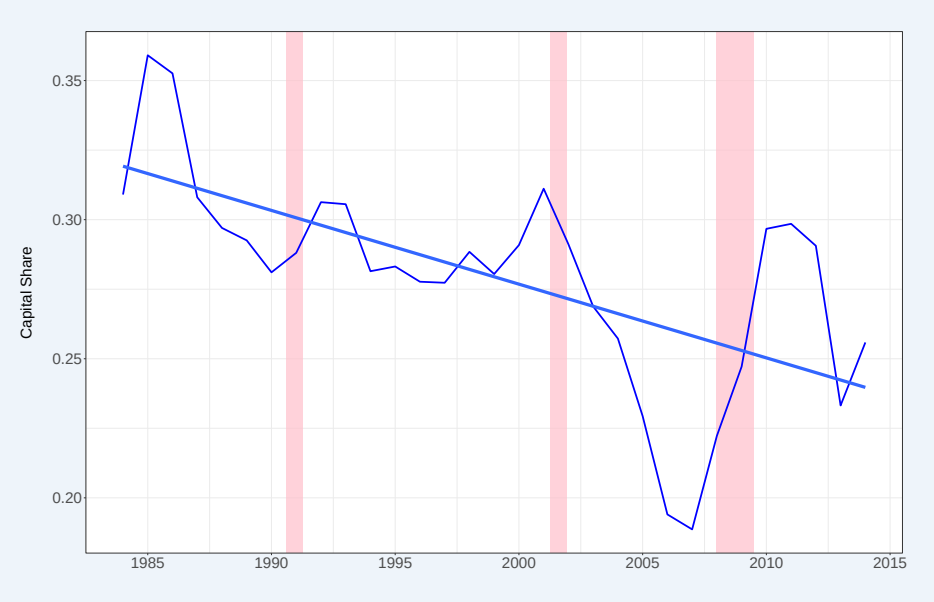


Figure 2: **Capital and Pure Profit Shares**
The figure shows the capital share and pure profit share of gross value added for the U.S. non-financial corporate sector over the period 1984–2014. Capital costs are the product of the required rate of return on capital and the value of the capital stock. The required rate of return on capital is calculated as $\left(\left(\frac{D}{D+E}i^D\left(1-\tau\right)+\frac{E}{D+E}i^E\right)-\mathbb{E}\left[\pi\right]+\delta\right)\frac{1-z\times\tau}{1-\tau}$. Expected capital inflation is calculated as a three-year moving average of realized capital inflation. Pure profits are gross value added less compensation of employees less capital costs less taxes on production and imports plus subsidies, $\Pi = P^Y Y - wL - RP^K K -$ taxes on production and imports less subsidies. Panel A: the capital share is the ratio of capital costs to gross value added. Panel B: the pure profit share is the ratio of pure profits to gross value added. Both figures include a fitted linear trend. See Section 3 for further details.

(a) Capital Share



(b) Pure Profit Share

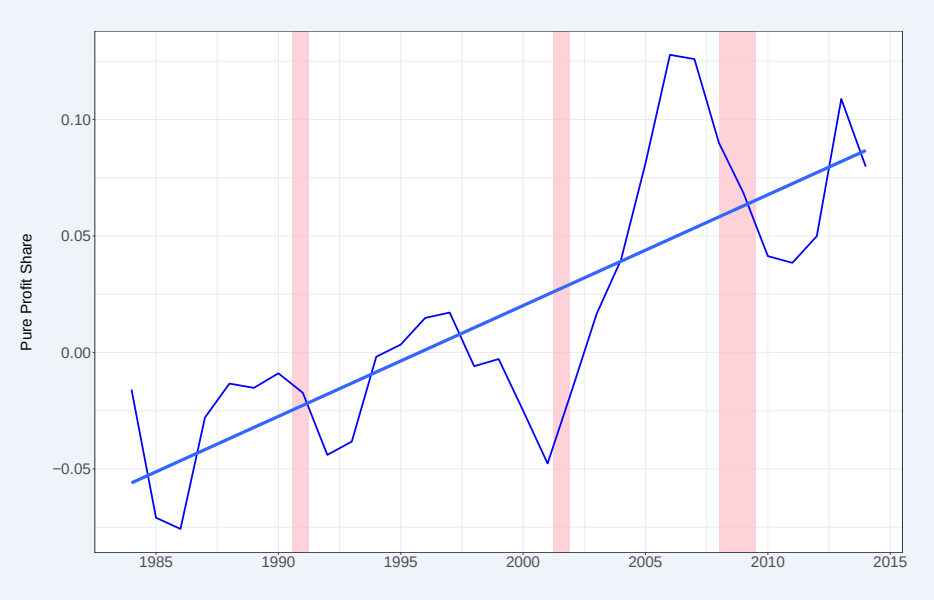
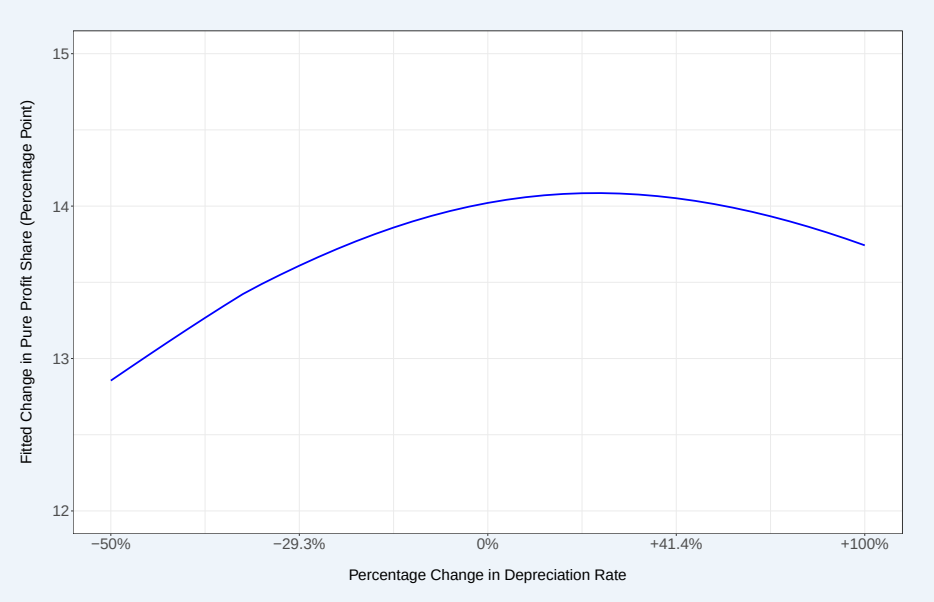


Figure 3: **Alternative Values of the Rate of Depreciation and Capital Inflation**
The figure shows the fitted change in the pure profit share and the fitted value of the pure profit share in 2014 for a range of adjustments to the rate of depreciation and capital inflation. Panel A presents the fitted change in the pure profit share for a range of adjustments to the rate of depreciation. Panel B presents the fitted value of the pure profit share in 2014 for a range of adjustments to the rate of depreciation. Panel C presents the fitted change in the pure profit share for a range of adjustments to capital inflation. Panel D presents the fitted value of the pure profit share in 2014 for a range of adjustments to capital inflation. See Section 3.5.2 for further details.

(a) Fitted Change in Pure Profit Share - Alternative δ



(b) Fitted 2014 Value of Pure Profit Share - Alternative δ

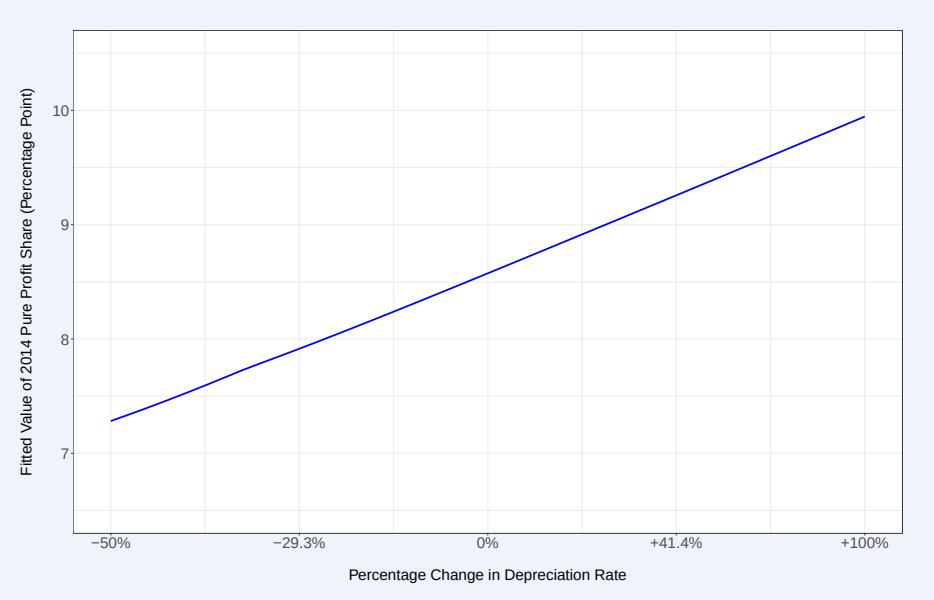
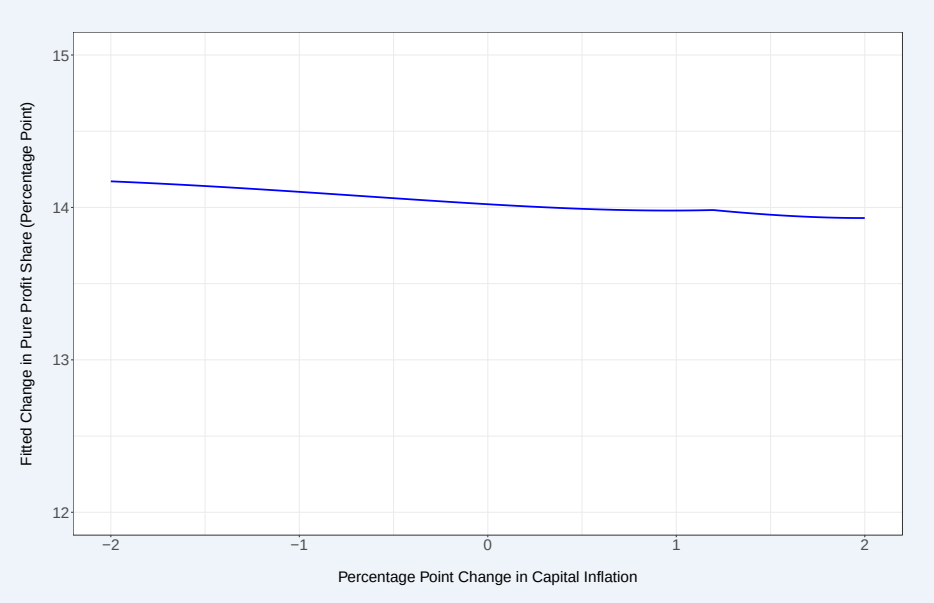


Figure 3: **Alternative Values of the Rate of Depreciation and Capital Inflation** (continued from previous page)

(c) Fitted Change in Pure Profit Share - Alternative Capital Inflation



(d) Fitted 2014 Value of Pure Profit Share - Alternative Capital Inflation

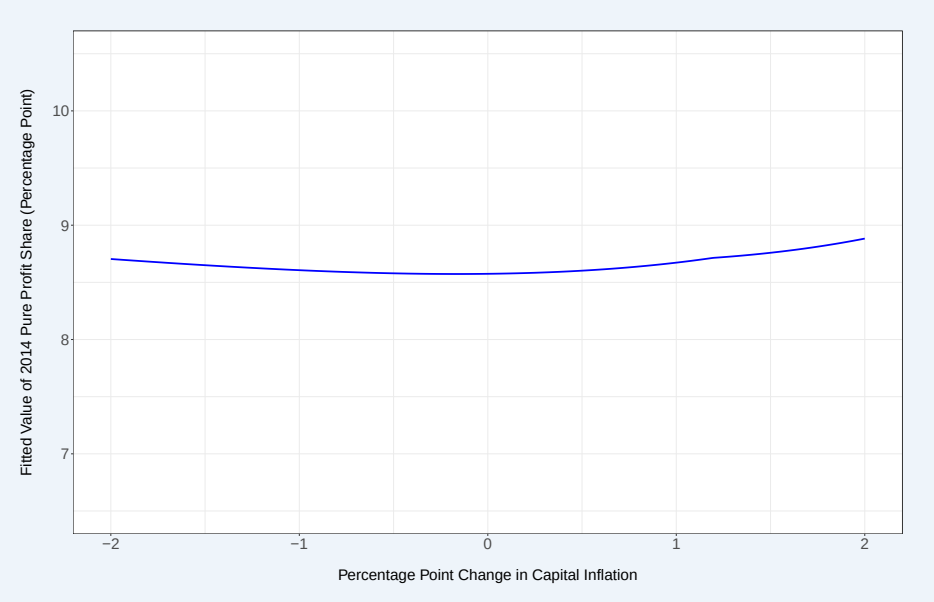


Figure 4: **Ratio of Investment to Gross Value Added**
This figure shows the ratio of investment to gross value added for the U.S. non-financial corporate sector over the period 1984–2014. See Section 3.7.1 for further details.

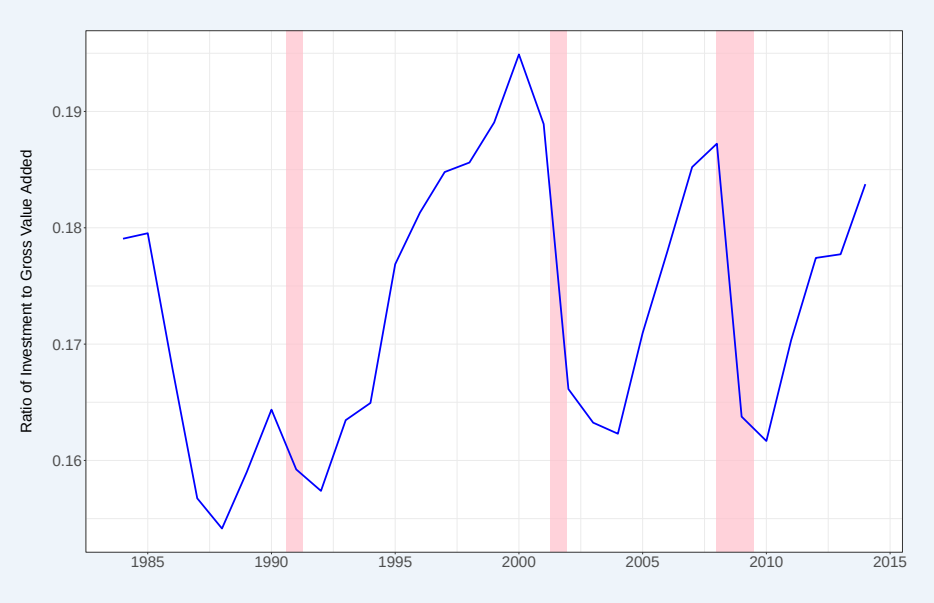


Table 1: **Time Trends of Labor, Capital, and Profits**
The table reports time trends for the U.S. non-financial corporate sector over the period 1984–2014. Capital costs are the product of the required rate of return on capital and the value of the capital stock. The required rate of return on capital is specified in each column of the table. Expected capital inflation is calculated as a three-year moving average of realized capital inflation. Pure profits are gross value added less compensation of employees less capital costs less taxes on production and imports plus subsidies, $\Pi = P^Y Y - wL - RP^K K - \text{topils}$. The labor share is the ratio of compensation of employees to gross value added. The capital share is the ratio of capital costs to gross value added. The pure profit share is the ratio of pure profits to gross value added. For a variable X, the fitted percentage point (pp) change in X is $\hat{X_{2014}} - \hat{X_{1984}}$, and the fitted percent (%) change in X is $\frac{\hat{X_{2014}} - \hat{X_{1984}}}{\hat{X_{1984}}}$. The increase in pure profits per employee is the fitted percentage point change in the pure profit share multiplied by gross value added in 2014 and divided by the number of employees in 2014. See Section 3 for further details.

	Required Rate of Return		
	(1 – Main)	(2)	(3)
Decline in Labor Share	10%	10%	10%
Decline in Required Rate of Return	31%	41%	36%
Decline in Capital Share	25%	36%	30%
Increase in Pure Profit Share	14.3pp	16.1pp	15.8pp
Increase in Pure Profits Per Employee	\$15.1 (thousand)	\$17.1 (thousand)	\$16.7 (thousand)

(1) $R = \left(\left(\frac{D}{D+E} i^D (1-\tau) + \frac{E}{D+E} i^E\right) - \mathbb{E}[\pi] + \delta\right) \frac{1 - z \times \tau}{1-\tau}$

(2) $R = \left(i^D - \mathbb{E}[\pi] + \delta\right)$

(3) $R = \left(\left(\frac{D}{D+E} i^D + \frac{E}{D+E} i^E\right) - \mathbb{E}[\pi] + \delta\right)$

Table 2: **Time Trends: Robustness to Alternative Measures of Capital**
The table reports time trends for the U.S. non-financial corporate sector over the period 1984–2014. This table considers alternative measures of capital. BEA capital data are taken from BEA Fixed Asset Table 4.1 and include structures, equipment, and intellectual property products. Data on inventories and real estate valued at market prices are taken from the Integrated Macroeconomic Accounts for the United States Table S.5.a. Capital data for column 1 consists of BEA capital and inventories. Capital data for column 2 consists of BEA capital. Capital data in column 3 consists of BEA capital and inventories and real estate is valued at market prices. See notes to Table 1 for variable definitions. See Section 3 for further details.

	Measure of Capital		
	(1 – Main)	(2)	(3)
Decline in Labor Share	10%	10%	10%
Decline in Required Rate of Return	31%	31%	35%
Decline in Capital Share	25%	20%	35%
Increase in Pure Profit Share	14.3pp	12.2pp	19.0pp
Increase in Pure Profits Per Employee	$15.1 (thousand)	$13.0 (thousand)	$20.1 (thousand)

(1) BEA Measures of Capital and Inventories

(2) BEA Measures of Capital

(3) BEA Measures of Capital, Inventories, and Real Estate Valued at Market Prices

Table 3: **Parameter Inputs into Missing Capital Scenarios**
The table reports the functional form assumptions and the range of parameter values for the construction of unmeasured intangible capital. I^X is nominal investment in unmeasured intangible capital. π^X is inflation of unmeasured intangible capital. δ^X is the rate of depreciation of unmeasured intangible capital. $P^X X$ is the nominal value of unmeasured intangible capital. $P^Y Y$ is measured gross value added and π^Y is the percent change in the price deflator of gross value added for the non-financial corporate sector (taken from NIPA Table 1.14). The nominal value of unmeasured capital at the end of period t is constructed by the perpetual inventory method and is given by the equation $P_t^X X_{t+1} = \left(1-\delta^X\right) P_t^X X_t + I_t^X$. Data on Economic Competencies are taken from IntanInvest. Data on Intellectual Property Products are taken from the BEA Fixed Asset Table 4.1. See Section 3.5.4 for further details.

			Fitted Values	
Input	Assumed Form	Range of Values	Economic Competencies	Intellectual Property Products
Investment	$\frac{I_t^X}{P_t^Y Y_t} = a + b \times (t - 1984)$	$a \in [0, 0.2]$	$a = 0.079$	$a = 0.035$
		$b \in [0, 0.01]$	$b = 0.001$	$b = 0.001$
Inflation	$\pi_t^X = \pi_t^Y + c + d \times (t - 1984)$	$c \in [-0.02, 0.02]$	$c = 0.015$	$c = 0.002$
		$d \in [-0.001, 0.001]$	$d = -0.0017$	$d = -0.0001$
Depreciation	$\delta^X = e$	$e \in [0.05, 0.6]$	$e = 0.436$	$e = 0.227$
Initial Stock	$P_{1975}^X X_{1975} = f \times P_{1975}^Y Y_{1975}$	$f \in [0, 2]$		$f = 0.106$

Table 4: **Model-Based Counterfactuals (Percentage Change Across Steady State)**
σ is the elasticity of substitution between labor and capital. Rows 1–3 present steady-state changes in response to the increase in markups and the decline in the real interest rate. Rows 4–6 present the gaps in output, wages, and investment that are due to the increase in markups. See Section 4.3 for further details.

	$\sigma = 0.4$	$\sigma = 0.5$	$\sigma = 0.6$	$\sigma = 0.7$	Data
Labor share	-9.5	-10.3	-11.2	-12.2	-10.2
Capital share	-30.5	-28.2	-25.7	-23.2	-24.9
Investment-to-output	14.2	18.1	22.1	26.2	7.1
Output gap	-8.2	-8.7	-9.3	-10.0	
Wage gap	-18.8	-19.0	-19.2	-19.4	
Investment gap	-14.1	-16.0	-17.9	-19.8	

Table 5: **Descriptive Statistics**
The table reports descriptive statistics of the matched sample of census industries. Data on industry payrolls, sales and concentration are taken from the economic census. The unit of observation is a six-digit NAICS industry. See Section 5.1 for further details.

	N	Median	Mean	S.D.
Value in 1997				
Labor Share	750	19.80	21.47	11.87
Sales Share of 4 Largest Firms	748	25.95	30.57	20.87
Sales Share of 8 Largest Firms	747	37.40	40.09	24.62
Sales Share of 20 Largest Firms	750	52.15	52.13	27.31
Sales Share of 50 Largest Firms	749	67.00	63.02	27.85
Value in 2012				
Labor Share	750	17.70	20.28	12.88
Sales Share of 4 Largest Firms	748	32.50	35.85	21.78
Sales Share of 8 Largest Firms	747	44.10	45.86	24.72
Sales Share of 20 Largest Firms	750	60.05	57.84	26.47
Sales Share of 50 Largest Firms	749	75.50	68.22	26.42
Change in Value (1997–2012)				
Labor Share	750	-1.41	-1.19	5.90
Sales Share of 4 Largest Firms	748	4.15	5.28	12.10
Sales Share of 8 Largest Firms	747	4.70	5.77	11.80
Sales Share of 20 Largest Firms	750	4.10	5.71	10.93
Sales Share of 50 Largest Firms	749	3.20	5.20	9.86
Log-Change in Value (1997–2012)				
Labor Share	750	-0.08	-0.10	0.28
Sales Share of 4 Largest Firms	748	0.17	0.21	0.46
Sales Share of 8 Largest Firms	747	0.13	0.18	0.38
Sales Share of 20 Largest Firms	750	0.09	0.14	0.30
Sales Share of 50 Largest Firms	749	0.05	0.11	0.23

Table 6: **Labor Share and Industry Concentration – Regression in First Differences**
The table reports results of regressions of changes in the labor share on changes in industry concentration. The unit of observation is a six-digit industry. Observations are weighted by an industry's share of sales. Standard errors are clustered by three-digit NAICS industry. Data on industry payrolls, sales, and concentration are taken from the economic census. The observed decline is the sales-weighted average change in the labor share. The predicted decline is the sales-weighted average predicted change in the labor share. See Section 5.2 for further details.

	Dependent variable:			
	$S^L_{j,t} - S^L_{j,t-5}$			
	(1)	(2)	(3)	(4)
$C^{(4)}_{j,t} - C^{(4)}_{j,t-5}$	-0.113^{***}			
	(0.029)			
$C^{(8)}_{j,t} - C^{(8)}_{j,t-5}$		-0.108^{***}		
		(0.028)		
$C^{(20)}_{j,t} - C^{(20)}_{j,t-5}$			-0.125^{***}	
			(0.031)	
$C^{(50)}_{j,t} - C^{(50)}_{j,t-5}$				-0.133^{***}
				(0.036)
Year FE	Yes	Yes	Yes	Yes
R^2 (Within)	0.07	0.06	0.07	0.06
Observations	2,224	2,232	2,229	2,235
Observed Decline	-0.81	-0.84	-0.81	-0.80
Predicted Decline	-0.84	-0.98	-1.25	-1.24
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 7: **Labor Share and Industry Concentration – Regression in Log Differences**
The table reports results of regressions of log-changes in the labor share on log-changes in industry concentration. The unit of observation is a six-digit industry. Observations are weighted by an industry's share of sales. Standard errors are clustered by three-digit NAICS industry. Data on industry payrolls, sales, and concentration are taken from the economic census. The observed decline is the sales-weighted average change in the log-labor share. The predicted decline is the sales-weighted average change in the predicted change in the log-labor share. See Section 5.2 for further details.

	Dependent variable:			
	$\log S^L_{j,t} - \log S^L_{j,t-5}$			
	(1)	(2)	(3)	(4)
$\log C^{(4)}_{j,t} - \log C^{(4)}_{j,t-5}$	-0.215^{***}			
	(0.079)			
$\log C^{(8)}_{j,t} - \log C^{(8)}_{j,t-5}$		-0.242^{**}		
		(0.110)		
$\log C^{(20)}_{j,t} - \log C^{(20)}_{j,t-5}$			-0.318^{**}	
			(0.151)	
$\log C^{(50)}_{j,t} - \log C^{(50)}_{j,t-5}$				-0.424^{**}
				(0.197)
Year FE	Yes	Yes	Yes	Yes
R^2 (Within)	0.07	0.06	0.06	0.06
Observations	2,224	2,232	2,229	2,235
Observed Decline	-0.22	-0.22	-0.22	-0.22
Predicted Decline	-0.07	-0.08	-0.08	-0.09
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 8: **Labor Share and Industry Concentration – By Subsample**
The table reports results of regressions of changes in the labor share on changes in industry concentration. The unit of observation is a six-digit NAICS industry. Observations are weighted by an industry's share of sales. Standard errors are clustered by three-digit NAICS industry. Data on industry payrolls, sales, and concentration are taken from the economic census. The observed decline is the sales-weighted average change in the labor share. The predicted decline is the sales-weighted average predicted change in the labor share. The classification of tradable industries is taken from Mian and Sufi (2014). Column 4 excludes Health Care and Social Assistance (NAICS 62) and Other Services (NAICS 81). The classification on R&D industries is based on the NSF R&D survey. See Section 5.4 for further details.

	Dependent variable:				
	$S^L_{j,t} - S^L_{j,t-5}$				
	Full Sample	Excluding Tradable Industries	Tradable Industries	Excluding Sectors with Tax-Exempt Firms	Excluding R&D Industries
	(1)	(2)	(3)	(4)	(5)
$C^{(4)}_{j,t} - C^{(4)}_{j,t-5}$	-0.113^{***}	-0.131^{***}	-0.036^{*}	-0.119^{***}	-0.125^{***}
	(0.029)	(0.033)	(0.022)	(0.029)	(0.031)
Year FE	Yes	Yes	Yes	Yes	Yes
R^2 (Within)	0.07	0.08	0.02	0.08	0.09
Observations	2,224	1,503	721	2,008	2,011
Observed Decline	-0.81	-0.48	-2.30	-0.75	-0.72
Predicted Decline	-0.84	-1.04	-0.18	-0.93	-1.01

Note: *p<0.1; **p<0.05; ***p<0.01

A Measures of the Equity Risk Premium

This appendix presents the equity cost of capital implied by the 20 models in Duarte and Rosa (2015) and compares these measures of the equity cost of capital to my approximation, which is equal to the sum of the yield on the ten-year U.S. treasury and a 5% equity risk premium. The models and data are taken directly from Duarte and Rosa (2015). See Duarte and Rosa (2015) for complete details.

Table A.1 presents a description of the 20 models. The models are split into five types. The first type, titled "historical mean of realized returns," measures the equity risk premium from the historical excess return of the market over a risk-free rate. The second type, titled "discounted cash flows," combines market data with a model of discounted dividends, earnings, or free cash-flows to infer the equity risk premium. The third type, titled "cross-sectional regression model," infers the equity risk premium from two-stage cross-sectional regressions. The first stage measures portfolio loadings on excess market returns and other factors and the second stage recovers the excess return on the market by regressing realized excess portfolio returns on the first-stage loadings. The fourth type, titled "time-series regression model," constructs the equity risk premium as the predicted values of time series predictive regressions of excess returns. The fifth and last type, titled "survey," constructs the equity risk premium from the Duke survey of CFOs.

Figure A.1 shows the equity cost of capital for each of the 20 models of Duarte and Rosa (2015). Each panel corresponds to one of the models described in Table A.1. In each panel, the solid blue line represents the equity cost of capital implied by the model, equal to the sum of the one-year treasury bill and the equity risk premium, and the dashed black line represents the sum of the yield on the ten-year U.S. treasury and a 5% equity risk premium. An equity risk premium of 5% relative to a 10-year treasury bond implies an average risk premium of 6.5% relative to the one-year treasury bill that has increased since 2008 to 7.4%.

The different types of models imply different levels of equity cost of capital. Regression models tend to show a level of the equity cost of capital that is higher than the historical mean of realized returns, the discounted cash flow models, and the Duke survey of CFOs. In addition to the difference in level, the regression models tend to show a higher standard deviation of the equity cost of capital. Several of the models display problematic features. Nine of the models predict a negative expected return on the market (models 2, 3, 5, 7, 8, 14, 15, 17, and 19) and two models predict an average negative expected return on the market in excess of the risk-free rate (models 4 and 8). Five of the models imply an equity risk premium that exceeds 20% (models 2, 14, 16, 17, and 18).

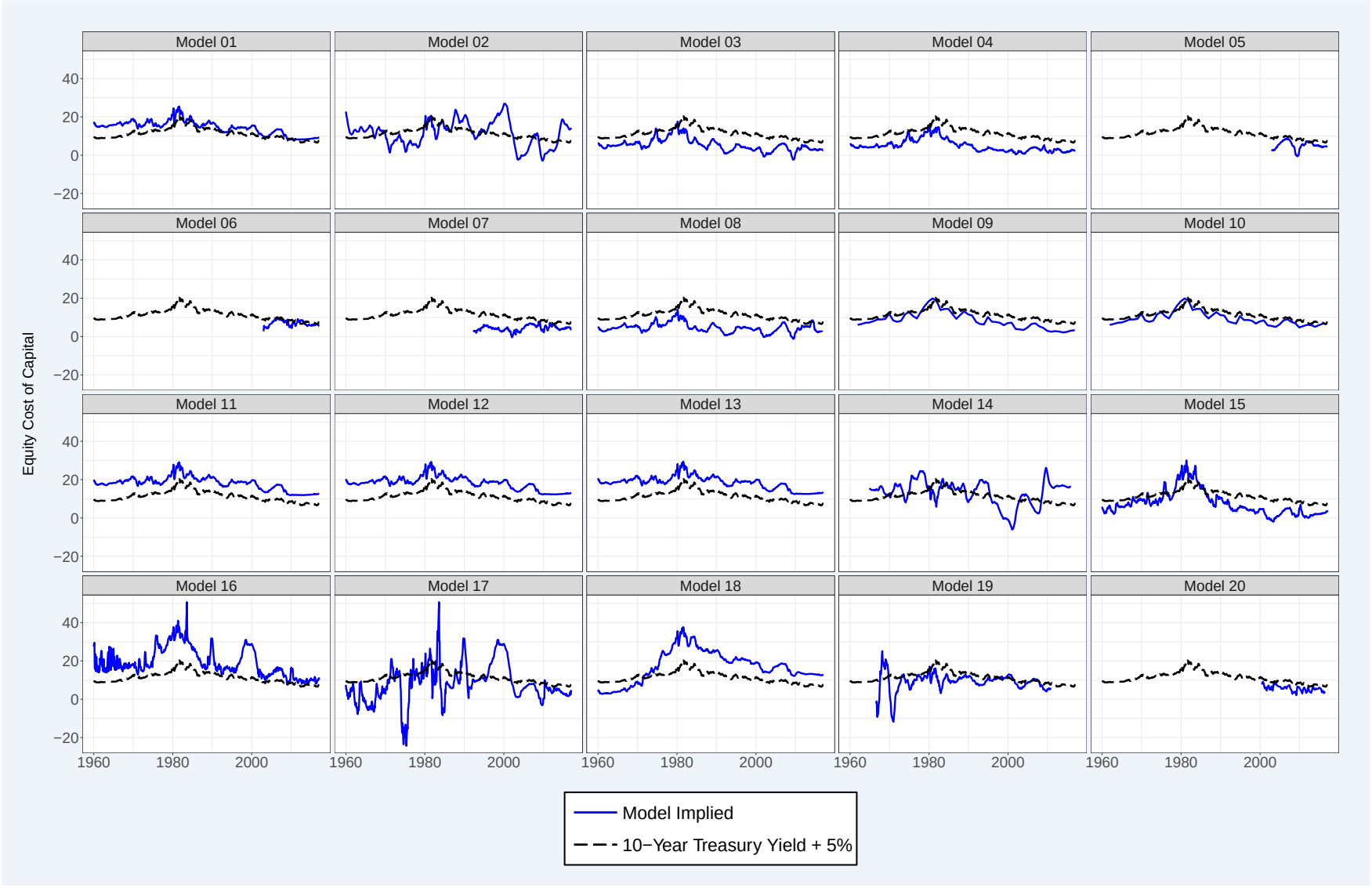
Most of the model-based measures of the equity cost of capital show that the sum of the yield on the ten-year U.S. treasury and a 5% equity risk premium provides a good approximation to both the level and trend of the equity cost of capital. Most of the models show a significant decline in the equity cost of capital

since the early 1980s that is either of the same magnitude or larger than the decline in the yield of the ten-year U.S. treasury. As noted above, the different types of models imply different levels of equity cost of capital. The level of sum of the yield on the ten-year U.S. treasury and a 5% equity risk premium falls in the middle range: it is in line with models of historical means, in line with the highest values of the discounted cash flow models, and in line with the lowest values of the regression models.

Table A.1: **Models of the Equity Risk Premium**
This table presents a description of the 20 models of the equity risk premium that appear in Duarte and Rosa (2015). See Appendix A and Duarte and Rosa (2015) for further details.

Model	Type	Citation	Description
1	Historical mean of realized returns		Historical mean as far back as data allow
2	Historical mean of realized returns		Historical mean using last five years
3	Discounted cash flows	Gordon (1962)	E/P minus nominal 10yr yield
4	Discounted cash flows	Shiller (2005)	1/CAPE minus nominal 10yr yield
5	Discounted cash flows	Gordon (1962)	E/P minus real 10yr yield
6	Discounted cash flows	Gordon (1962)	Expected E/P minus real 10yr yield
7	Discounted cash flows	Gordon (1962)	Expected E/P minus nominal 10yr yield
8	Discounted cash flows	Panigirtzoglou and Loeys (2005)	Two-stage DDM
9	Discounted cash flows	Damodaran (2012)	Six-stage DDM by Damodaran
10	Discounted cash flows	Damodaran (2012)	Six-stage free cash flow DDM by Damodaran
11	Cross-sectional regression model	Fama and French (1992)	Fama-French
12	Cross-sectional regression model	Carhart (1997)	Fama-French and momentum
13	Cross-sectional regression model	Duarte (2013)	Fama-French, momentum and inflation
14	Cross-sectional regression model	Adrian, Crump and Moench (2014)	Adrian, Crump, and Moench
15	Time-series regression model	Fama and French (1988)	Time-series predictor is D/P
16	Time-series regression model	Goyal and Welch (2008)	Best predictor in Goyal and Welch
17	Time-series regression model	Campbell and Thompson (2008)	Best predictor in Campbell and Thompson
18	Time-series regression model	Fama and French (2002)	Best predictor in Fama French 2002
19	Time-series regression model	Baker and Wurgler (2007)	Baker–Wurgler sentiment measure
20	Survey	Graham and Harvey (2012)	Duke survey of CFOs

Figure A.1: **The Equity Cost of Capital**
This figure shows the equity cost of capital for each of the 20 models of Duarte and Rosa (2015). Each panel corresponds to one of the models described in Table A.1. In each panel, the solid blue line represents the equity cost of capital implied by the model, equal to the sum of the equity risk premium and the one-year treasury bill, and the dashed black line represents the sum of the yield on the ten-year U.S. treasury and a 5% equity risk premium. See Appendix A and Duarte and Rosa (2015) for further details.



B Adjustment Costs and the Pure Profit Share

In this appendix, I incorporate quadratic adjustment costs into a baseline model of monopolistic competition. In the model, firms own the capital stock and choose a path of investment that maximizes their market value. In the model, I mimic the empirical measurement of capital costs and pure profits. I calculate capital costs as $(r + \delta) \times K$ and I calculate pure profits as gross operating surplus less capital costs.

For a wide range of adjustment cost parameters, I compute the unconditional means and standard deviations of the labor, capital, and pure profit shares. I find that these unconditional means are insensitive to the adjustment cost parameter. In this sense, a change to the adjustment cost parameter should not result in a change to the long-run level of the labor share or pure profit share.

In addition, for different values of the adjustment cost parameter I compute the pairwise correlations of the labor, capital, and pure profit shares. For any positive adjustment cost parameter, the labor and pure profit shares are procyclical and positively correlated. Models with higher values of the adjustment cost parameter feature higher correlations between the labor and pure profit shares. These results suggest that a path of shocks that lead to higher measured pure profits should also lead to a higher labor share.

This appendix is organized as follows. Section B.1 presents the model, Section B.2 calibrates the model, Section B.3 describes the measurement of capital costs and pure profits, and Section B.4 presents the numerical results.

B.1 Setup

B.1.1 Households

A representative household is infinitely lived and has preferences over its consumption $\{C_t\}$ and its labor $\{L_t\}$ that are represented by the utility function

$$\mathbb{E}\left[\sum_t \beta^t u\left(C_t, L_t\right)\right] \tag{B.1}$$

The economy has a single savings vehicle in the form of equity in the corporate sector. Households are endowed with all equity shares. Equity shares are in zero net supply and the number of shares is normalized to 1. The household chooses a sequence for consumption $\{C_t\}$, labor $\{L_t\}$, and equity shares $\{S_t\}$ to maximize utility subject to the sequence of budget constraints

$$P_t^Y C_t + \left(S_t - S_{t-1}\right) V_t = w_t L_t + S_{t-1} Div_t \tag{B.2}$$

where Div_t are total corporate dividends, V_t is the end-of-period nominal value of one share of equity, and $(S_t - S_{t-1}) V_t$ are nominal purchases of equity shares.

B.1.2 Final Goods Producer

The corporate sector is made up of a unit measure of firms, each producing a differentiated intermediate good. The final good is produced in perfect competition as a CES aggregate of the intermediate goods

$$Y_t = \left(\int_0^1 y_{i,t}^{\frac{\varepsilon-1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}} \tag{B.3}$$

where $\varepsilon > 1$ is the elasticity of substitution between goods. The pure profits of the final goods producer are $P_t^Y Y_t - \int_0^1 p_{i,t} y_{i,t} di$, where P_t^Y is the exogenous price level of output and $p_{i,t}$ is the endogenous price of intermediate good i. The solution to the cost minimization problem, together with the zero pure profit condition of the final goods producer, leads to the following demand function for intermediate good i:

$$D_t(p_{i,t}) = Y_t \left(\frac{p_{i,t}}{P_t^Y} \right)^{-\varepsilon} \tag{B.4}$$

B.1.3 Firms

Firm i produces intermediate good $y_{i,t}$ using the constant return to scale production function

$$y_{i,t} = f_t(k_{i,t}, l_{i,t}) \tag{B.5}$$

where $k_{i,t}$ is the amount of capital used in production, and $l_{i,t}$ is the amount of labor used in production. The firm owns a stock of capital that evolves according to the law of motion

$$P_t^K k_{i,t+1} = (1-\delta) P_t^K k_{i,t} + P_t^K I_{i,t} - \frac{\psi}{2} \left(\frac{I_{i,t}}{k_{i,t}} - \delta \right)^2 P_t^K k_{i,t} \tag{B.6}$$

where P_t^K is the nominal price of capital, ψ is the adjustment cost parameter, and $\frac{\psi}{2} \left(\frac{I_{i,t}}{k_{i,t}} - \delta \right)^2 P_t^K k_{i,t}$ is the nominal adjustment cost. In period t the firm hires labor in a competitive spot market at the nominal wage rate w_t and produces good $y_{i,t}$, which is sold at price $p_{i,t}(y)$. After production the firm chooses investment and pays dividends

$$Div_{i,t} = p_{i,t} y_{i,t} - w_t l_{i,t} + P_t^K I_{i,t} \tag{B.7}$$

where $p_{i,t}y_{i,t}$ are the firm's revenues, $w_t l_{i,t}$ are the firm's labor costs, and $P_t^K I_{i,t}$ is gross nominal investment. The firm chooses a sequence for labor $\{l_{i,t}\}$, capital $\{k_{i,t}\}$, and investment $\{I_{i,t}\}$ to maximize the net present value of dividends

$$V_{i,t} = \max \mathbb{E}_t \left[\sum_{k \geq 0} \beta^k \frac{\Lambda_{t+k}}{\Lambda_t} Div_{i+t} \right] \tag{B.8}$$

where $\beta^k \frac{\Lambda_{t+k}}{\Lambda_t}$ is the household's marginal rate of substitution.

B.1.4 Capital Creation

I assume that all agents in the model have free access to a constant returns to scale technology that converts output into capital at a ratio of $1 : \kappa_t$. I further assume that this technology is fully reversible. Arbitrage implies that, in period t, κ_t units of capital must have the same market value as 1 unit of output. This pins down the relative price of capital

$$\frac{P_t^K}{P_t^Y} = \kappa_t^{-1} \tag{B.9}$$

B.1.5 Equilibrium

In equilibrium three markets will need to clear: the labor market, the market for consumption goods, and the market for firm equity. The aggregate resource constraint requires that nominal output is equal to the sum of nominal consumption and nominal gross investment.

B.2 Calibration

B.2.1 Functional Form Assumptions

Production. I assume that firms produce using a CES production function

$$y_{i,t} = Z_t A_H \left(\alpha_K \left(k_{i,t} \right)^{\frac{\sigma-1}{\sigma}} + (1 - \alpha_K) \left(l_{i,t} \right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{B.10}$$

where σ is the elasticity of substitution between labor and capital. In equilibrium, aggregate output is a CES aggregate of labor and capital with parameters that are identical to the firm-level production function

$$Y_t = Z_t A_H \left(\alpha_K \left(K_t \right)^{\frac{\sigma-1}{\sigma}} + (1 - \alpha_K) \left(L_t \right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{B.11}$$

Preferences. I assume that household flow utility from consumption C_t and labor L_t is represented by the utility function

$$u\left(C_t, L_t\right) = \log C_t - \gamma \frac{\theta}{\theta + 1} L_t^{\frac{\theta+1}{\theta}} \tag{B.12}$$

Total Factor Productivity. I assume that $\log Z_t$ follows an AR(1) process

$$\log Z_t = \rho \log Z_{t-1} + \eta_t \tag{B.13}$$

where the η_t are iid.

B.2.2 Normalization, Parameter Values, and Shock Distribution

I normalize the price of the final good to 1 $\left(P_t^Y = 1\right)$. I set the depreciation rate of capital to 0.1 and the relative price of capital to 1 $\left(P_t^K = 1; \delta = 0.1\right)$. I set the rate of time preference to 0.95 and I set θ to 2, and I calibrate γ to match steady-state labor of $\frac{1}{3}$. I set the elasticity of substitution between labor and capital to 0.6, I calibrate α_K to match a steady-state labor share of 0.712, and I choose A_H to normalize steady-state output to 1. I set the demand elasticity to match markups of 2.4% $\left(\varepsilon = \frac{1.024}{1.024-1}\right)$. Last, I set the AR(1) coefficient ρ to 0.95 and assume that the shocks η_t are iid normal with mean zero and standard deviation of 0.1.

B.3 Measuring Capital Costs and Pure Profits

Using the model I construct the equivalent of the empirical estimation of capital costs or pure profits. In the previous section I normalized the price of output and capital to 1 and I drop reference to these in the equations that follow.

- I calculate the firm's cost of capital r_t as expected return on firm equity at the end of period $t-1$.
- The required rate of return on capital is $R_t = r_t + \delta$.
- Capital costs are $R_t K_t$ and pure profits are $\Pi_t = Y_t - w_t L_t - R_t K_t$.
- The capital share is the ratio of capital costs to output and the pure profit share is the ratio of pure profits to output.

B.4 Solution and Model Statistics

I use the gEcon package for R to compute the model steady state and the first-order perturbation solution of the stochastic model. The model steady state does not depend on the adjustment cost parameter ψ. For each value of the adjustment cost parameter ψ, I solve the model and simulate 10,000 random paths, each of length 500 (I simulate paths of length 1,000 and burn the first 500 observations). In this exercise, the adjustment cost parameter ψ varies[42] from 0 to 40.

[42] This range includes implausibly high values of adjustment costs. See Tobin (1981) and Hall (2001) for further details.

B.4.1 Unconditional Means and Standard Deviations

Figure 1 presents the unconditional means and standard deviations of the labor share, capital share, and pure profit share for a range of values of the adjustment cost parameter ψ. The unconditional mean of each variable is measured as the percentage point deviation from its value in the common deterministic steady state. The height of each bar represents the unconditional standard deviation.

An increase in the adjustment cost parameter ψ has virtually no effect on the unconditional means of the labor share, capital share, and pure profit share. In all cases, the point estimate for the unconditional mean is near zero. An increase in the adjustment cost parameter ψ does have implications for the standard deviation of the output shares. An increase in the adjustment cost parameter reduces the standard deviation of the labor share and increases the standard deviations of the capital and pure profit shares.

B.4.2 Correlations

Table 1 presents the correlations of the labor share, capital share, pure profit share, and $\log(TFP)$ for two particular values of the adjustment cost parameter ψ. Panel A presents correlations for $\psi = 1$ (a low value) and Panel B presents correlations for $\psi = 32$ (a high value). The table shows a positive correlation between the labor share and the pure profit share and that both are procyclical. Furthermore, a higher value of ψ is associated with an increased correlation between the labor share and pure profit share.

Figure 2 presents the pairwise correlations of the labor share, capital share, and pure profit share for a wide range of values of the adjustment cost parameter ψ. For all positive values of ψ, the correlation between the labor share and the pure profit share is positive and increasing with the value of ψ. For all values of ψ, the correlation between the capital share and the pure profit share is negative and declining with the value of ψ. At high values of ψ the correlation between that capital share and pure profit share falls below 0.9.

Figure 1: **Unconditional Means and Standard Deviations**
The figure shows the unconditional means and standard deviations of the labor share, capital share, and pure profit share for a range of values of the adjustment cost parameter ψ. The unconditional mean of each variable is measured as the percentage point deviation from its value in the common deterministic steady state. The height of each bar represents the unconditional standard deviation. See Section B.4 for further details.

(a) Labor Share

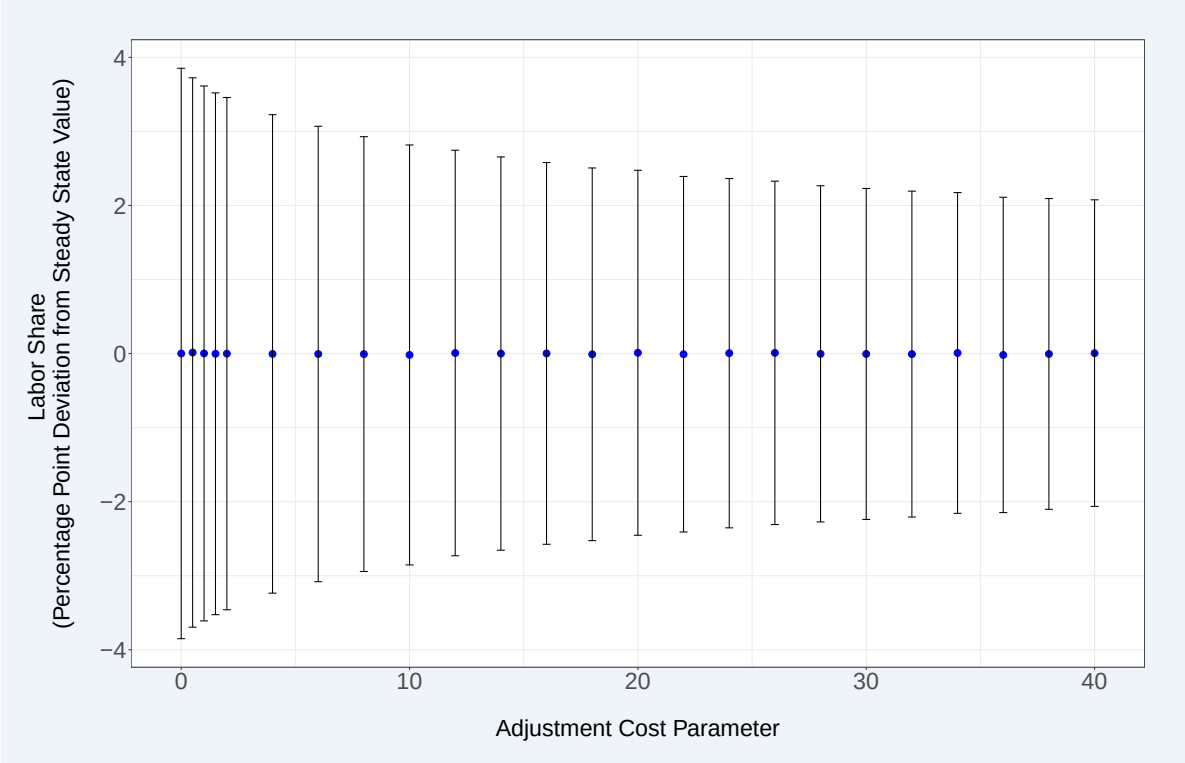
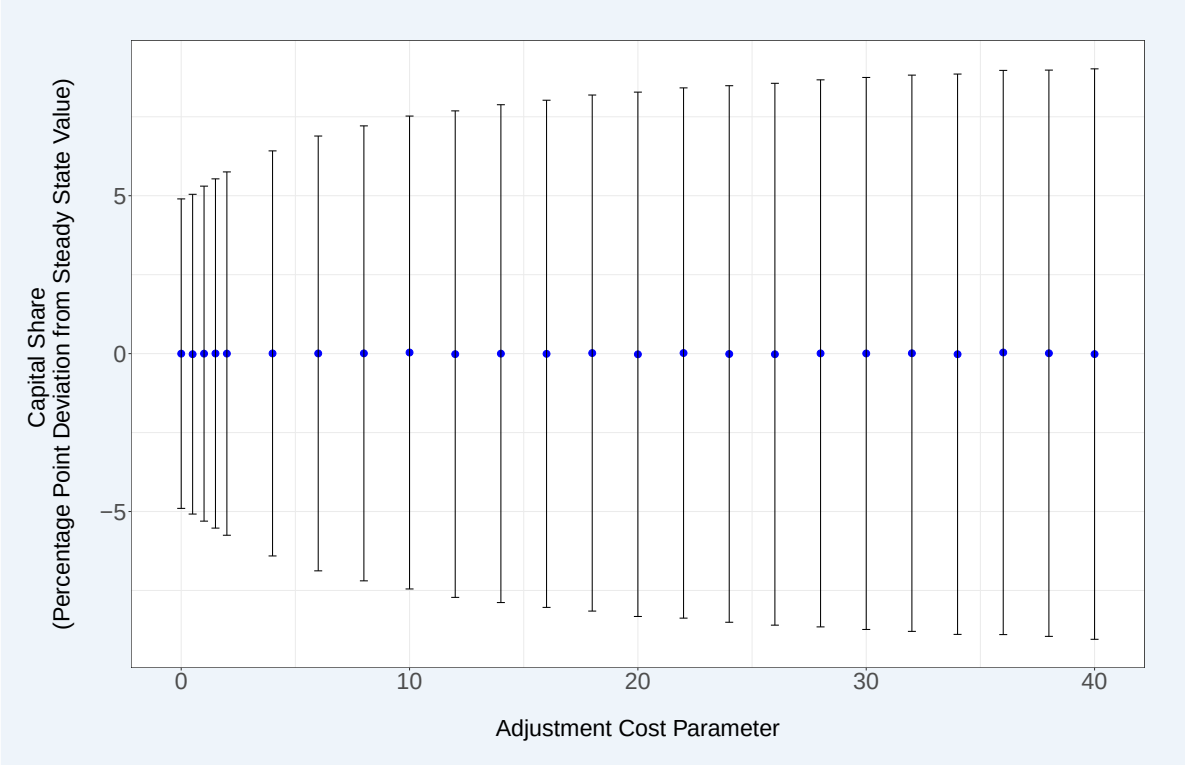


Figure B.1: **Unconditional Means and Standard Deviations** (continued from previous page)

(b) Capital Share



(c) Pure Profit Share

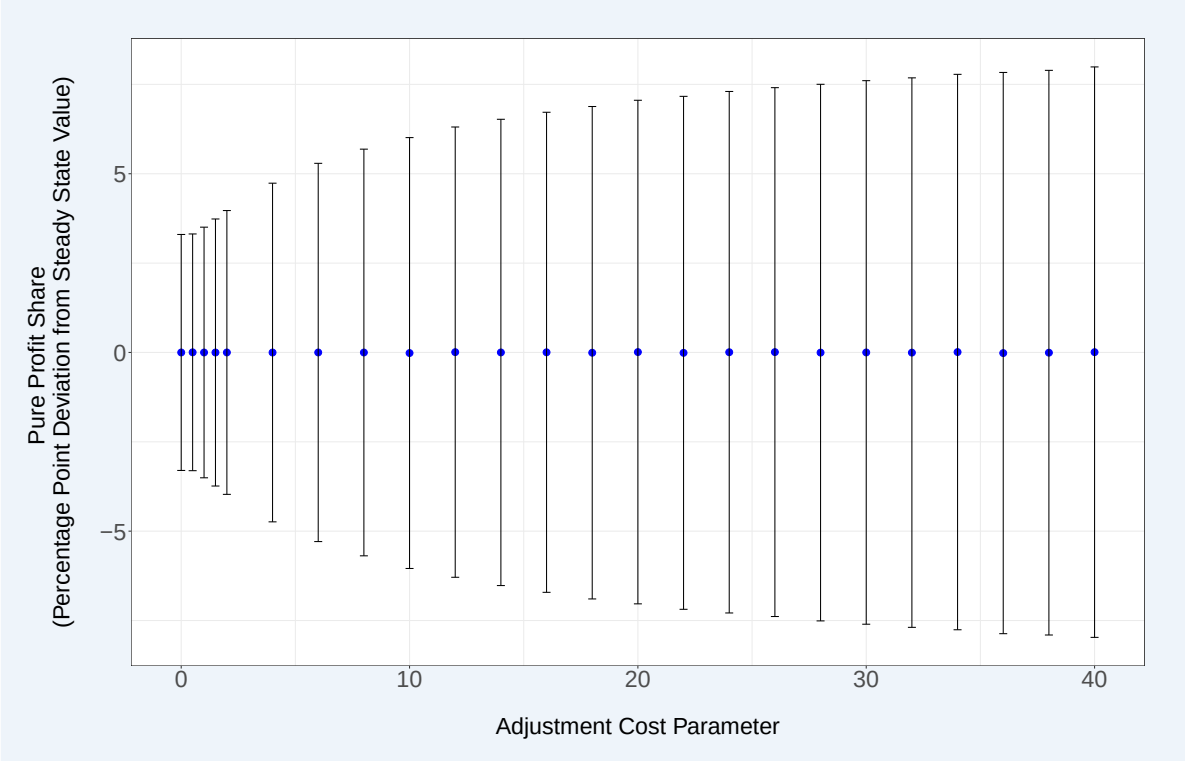


Figure 2: **Correlations**
The figure shows the pairwise correlations of the labor share, capital share, and pure profit share for a range of values of the adjustment cost parameter ψ. See Section B.4 for further details.

(a) cor(Labor Share, Pure Profit Share)

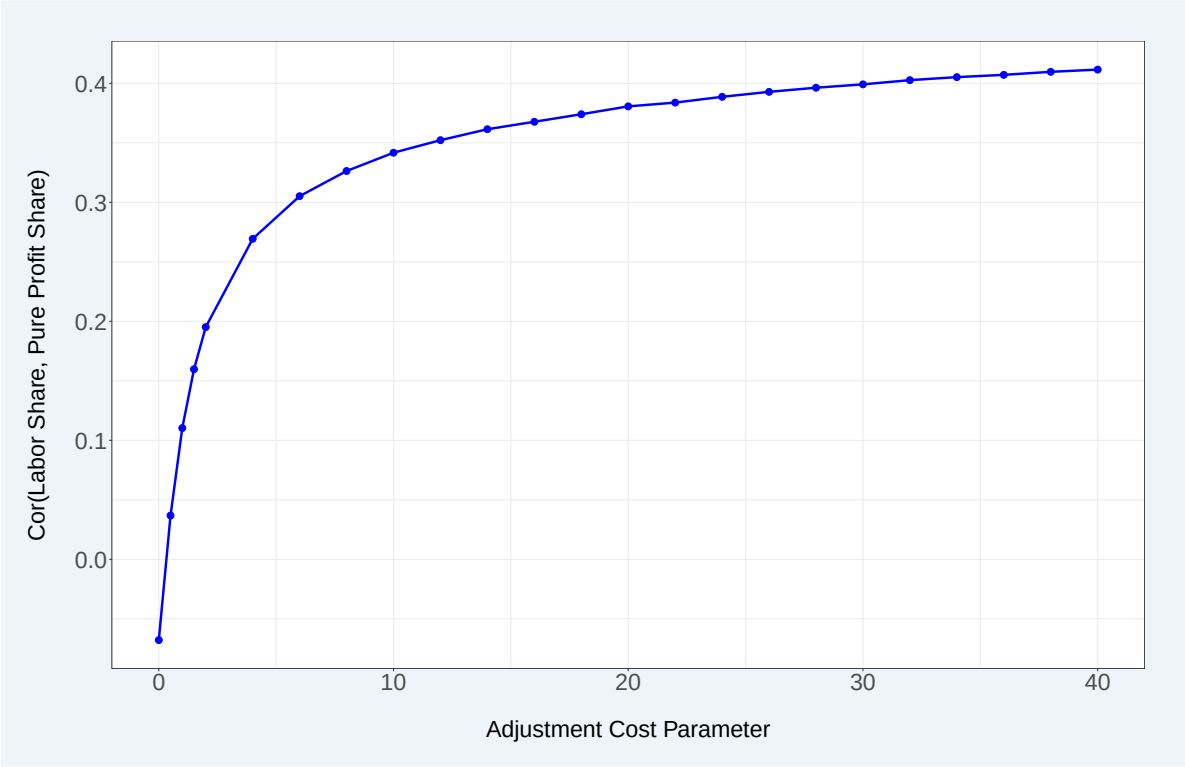
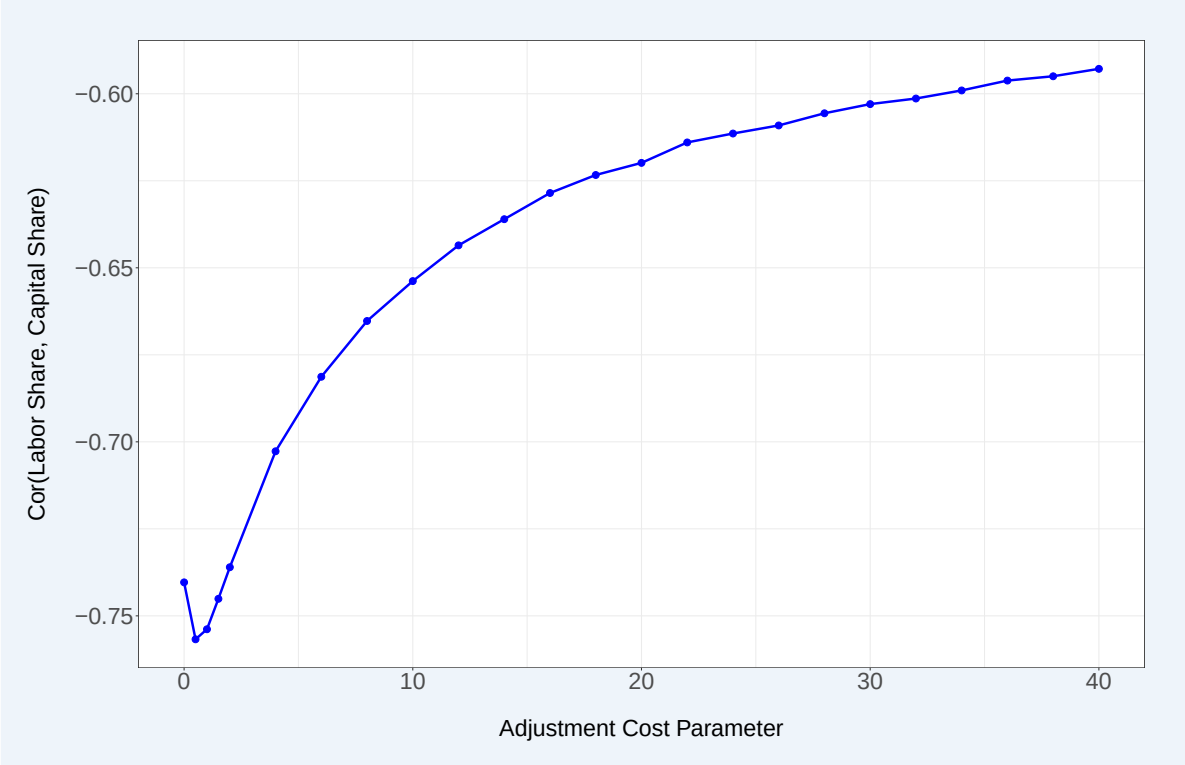


Figure B.2: **Correlations** (continued from previous page)

(b) cor(Labor Share, Capital Share)



(c) cor(Capital Share, Pure Profit Share)

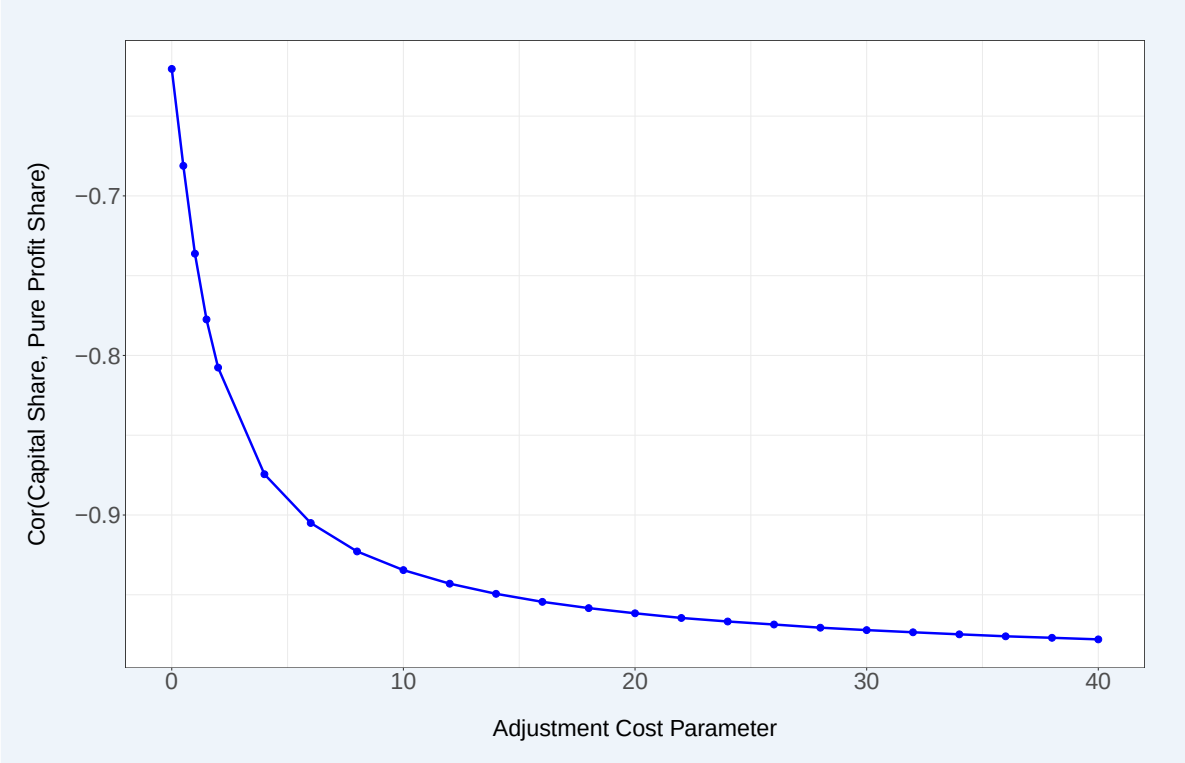


Table 1: **Correlation Matrix by Adjustment Cost Parameter**

(a) Low Adjustment Costs ($\psi = 1$)

	Labor Share	Capital Share	Pure Profit Share	log(TFP)
Labor Share	1.000	-0.754	0.110	0.842
Capital Share	-0.754	1.000	-0.736	-0.966
Pure Profit Share	0.110	-0.736	1.000	0.594
log(TFP)	0.842	-0.966	0.594	1.000

(b) High Adjustment Costs ($\psi = 32$)

	Labor Share	Capital Share	Pure Profit Share	log(TFP)
Labor Share	1.000	-0.601	0.403	0.741
Capital Share	-0.601	1.000	-0.973	-0.979
Pure Profit Share	0.403	-0.973	1.000	0.910
log(TFP)	0.741	-0.979	0.910	1.000