The Cross-Section of Labor Leverage and Equity Returns*

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Abstract

We study labor-induced operating leverage. Theoretically, we show that if labor markets are frictionless, two sufficient conditions for the existence of labor leverage are (a) relatively smooth wages and (b) a capital-labor elasticity of substitution strictly less than one. Our model provides theoretical support for the use of labor share—the ratio of labor expenses to value added—as a measure of labor leverage. We provide evidence for conditions (a) and (b), and we demonstrate the economic significance of labor leverage: High labor-share firms have operating profits that are more sensitive to economic shocks and have higher expected returns.

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Labor compensation is a major expense for firms: Despite its documented secular decline, the labor share still represents over 50% of the gross domestic product (GDP) in the United States. Magnitude, however, is not the only distinguishing property of labor compensation. For asset pricing, an arguably equally important property of labor compensation is its smoothness relative to firms’ cash inflows. This smoothness leads to a labor-induced form of operating leverage (henceforth labor leverage), which amplifies firm risk in a way analogous to financial leverage. While financial leverage has been extensively studied, there has been less work on labor leverage, likely because a theoretically supported empirical measure is lacking. This paper fills this gap and provides theoretical support and empirical validation for the firm-level labor share (i.e., the ratio between a firm’s labor expenses and its value added) as a new measure of firm-level labor leverage. Moreover, this paper presents new evidence for the economic significance of labor leverage in explaining cross-sectional differences in the riskiness of cash flows, and in expected returns.

Our first contribution, which is presented in Section 1, is to provide a simple analytical discussion of the theoretical link between labor leverage, labor share, and the cross-section of stock returns. Our model shows that even in a frictionless setting, the following two conditions are sufficient to create the labor leverage mechanism: (a) wages must be smoother than shocks to a firm’s output (e.g., productivity or demand shocks), and (b) labor and capital must be strict complements in a firm’s productive technology. The data support these two conditions for the existence of labor leverage. Aggregate wages are less volatile than productivity, as is well known in the macroeconomics literature; we also document that labor costs are significantly less variable than other costs: For instance, in our sample, a 1.0% reduction in sales is associated, on average, with a 0.43% reduction in staff (labor) expenses but also with a 1.07% reduction in all other costs. Finally, the model shows that the labor share is a correct proxy for labor leverage.

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1 More generally, Gollin (2002) finds that labor share is between 0.65 and 0.80 across most of the developed countries included in his sample. For a discussion of the global decline in labor share, see Piketty (2014), Karabarbounis and Neiman (2014), and Hartman-Glaser, Lustig, and Xiaolan (2017). Hartman-Glaser et al. (2017) document an increase in labor share for the median U.S. firm, despite the decline in aggregate labor share. Kehrig and Vincent (2017) find that, despite the aggregate labor share decline, labor expenses remain high for the vast majority of establishments.

2 The widely used Cobb-Douglas productive technology does not allow for this possibility, since it constrains the elasticity of substitution between labor and capital to unity. As a result, models using Cobb-Douglas production functions do not generate labor leverage if labor markets are frictionless.

3 As discussed by León-Ledesma, McAdam, and Willman (2010); and Klump, McAdam, and Willman (2012); among others, there is strong empirical evidence in the literature that the elasticity of substitution between capital and labor is less than one, especially at the firm level.
Our second and main contribution, which is presented in Section 2, is to test the empirical predictions of this simple theory. Crucial to our work is the measurement of the labor share at the firm level. We consider three alternative measures of labor share. The first two measures are based on Compustat data and cover all non-financial industries. One limitation of these two measures is that only a minority of firms in these data report labor compensation, so we either have to use a smaller sample or we have to resort to some imputation. This leads us to also consider a third measure, which is based on restricted-access establishment-level Census data (then merged to Compustat). These data have the advantage of being of higher quality but cover only manufacturing industries. We validate our three measures of labor share by showing that they are strongly correlated with each other, and that each of them is positively related to operating leverage, i.e. the sensitivity of operating profits to economic shocks. In particular, we show that the sensitivity of profits to real GDP, aggregate TFP, and market return is positive for the average firm, and is cross-sectionally increasing in labor share. This result, besides supporting our labor leverage mechanism, also validates our Compustat-based labor share measure and suggests that future researchers who are unable to access Census data can use the proxies we construct in Compustat.

We next proceed to study the implications of our proposed mechanism for expected returns. Our theory predicts a positive relation between labor share and expected returns, as long as a firm’s productivity has a greater systematic risk loading than its wage rate. An equivalent sufficient condition is the greater volatility and procyclicality of productivity with respect to wages. To address the challenge that expected returns are not directly observable in the data, we use two different types of proxies for expected returns: realized equity returns and systematic risk loadings (i.e., betas on risk factors). We find supporting evidence that expected returns are increasing in labor share. In particular, we find that high labor share firms earn, on average, higher realized equity returns, and we find that these firms have higher betas.

Our final contribution (section 3) is to construct a production model (that nests the simple framework of section 1), which can match qualitatively but also quantitatively what we observe in the data. We present such a model and estimate it using standard moments for risky-asset returns, as well as novel moments related to labor leverage. This calibration delivers a set of results that closely match relevant moments found in the data, giving credence to our proposed mechanism. The success of the calibration of the model also supports the hypothesis that labor leverage is a first-order driver of cross-sectional variation of firms’ exposure to fundamental sources of risk and
thus of cross-sectional variation in expected returns.

This paper considers the simplest set of conditions that would generate a positive labor leverage that varies across firms. However, it is important to note that other mechanisms can generate similar results by introducing additional labor frictions.\footnote{Examples of alternative mechanisms that drive labor cost smoothness include: labor contracts that insure workers (e.g., Danthine and Donaldson (2002), Berk and Walden (2013), and Favilukis and Lin (2015)), unionization (e.g., Chen, Kacperczyk, and Ortiz-Molina (2012)), and labor mobility (e.g., Donangelo (2014)).} We view alternative mechanisms as complementary, since multiple channels are likely present in reality. Regardless of the channel, the previous literature has not empirically documented the relation between labor leverage and asset prices. The most significant contribution of our paper is the empirical evidence we provide for this relation.

This paper contributes to the literature that studies the relation between operating leverage and stock returns.\footnote{Some examples of this literature that focuses on the traditional (i.e., non labor-induced) form of operating leverage include: Lev (1974); Mandelker and Rhee (1984); Carlson, Fisher, and Giammarino (2004); Zhang (2005); and Novy-Marx (2011).} Within this literature, our paper is more closely related to the strand that discusses the relation between labor-induced forms of operating leverage and asset prices. Examples of this literature include Danthine and Donaldson (2002); Belo, Lin, and Bazdresch (2014); Donangelo (2014); Xiaolan (2014); and Favilukis and Lin (2015). Danthine and Donaldson (2002) discuss a mechanism in which countercyclical capital-to-labor share leads to labor-induced operating leverage in a general equilibrium setting. In their model, wages are less volatile than profits, due to the limited market participation of workers, and firms insure workers through labor contracts against labor risk. Stable wages act as an extra risk factor for shareholders, as markets are incomplete in their model. Donangelo (2014) proposes a model that establishes a positive connection between labor mobility and labor leverage. Labor intensity and labor mobility are two complementary mechanisms that affect a firm’s operating leverage. In a cyclical industry, the effect of labor mobility on firm risk is increasing in labor share, and the effect of labor share on firm risk is increasing in labor mobility. Most recently, Xiaolan (2014) derives predictions similar to our model based on the optimal implicit contract between workers and firms. Overall, the key difference is that our model dynamics stems from a simple spot labor market setting with realistic assumptions about labor demand and labor supply, while this literature focuses on implicit contracts and the ensuing insurance arrangements. We view these analyses as complementary, since both channels are likely
present in reality.\(^6\)

## 1 Theoretical Motivation

In this section, we present and analyze the labor leverage mechanism, and demonstrate why the labor share is a valid proxy for labor leverage. In the interest of clarity, this section makes several simplifying assumptions. The last section of the paper presents and estimates a dynamic model.

Consider a firm that produces value added \(Y\) according to

\[
Y_t = X_t F[K_t, L_t],
\]

(1)

where \(X\) denotes the firm’s total factor productivity (TFP), \(L\) denotes labor, \(K\) denotes capital, and \(F\) represents an homogeneous function of degree one.\(^7\) The firm takes as given the wage rate \(W\), which is set in an implicit perfect labor market. Capital adjustment costs are sufficiently high as to make capital fixed in the instant considered, \(K_t = K\). The firm’s profit maximization problem at time \(t\) then defines optimized operating profits \(\Pi\) as:

\[
\Pi_t = \max_{L_t} \{X_t F[K_t, L_t] - L_t W_t\},
\]

(2)

where \(W\) denotes the market wage, which is possibly correlated with the firm’s TFP. We define labor leverage as the ratio of the elasticity of operating profit to productivity and the elasticity of value added to productivity minus one.\(^8\) We can then relate labor leverage to other economic fundamentals through the following:

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\(^6\)Other papers that relate labor to finance issues are Peterson (1994); Santos and Veronesi (2006); Merz and Yashiv (2007); Chen and Zhang (2011); Chen et al. (2012); Eisfeldt and Papanikolaou (2013); Petrosky-Nadeau, Zhang, and Kuehn (2013); Kuehn, Simutin, and Wang (2017); Schmidt (2014); Favilukis, Lin, and Zhao (2015).

\(^7\)That is, the production technology has the constant-returns-to-scale property. Also, note that we refer throughout the paper to \(X\) as TFP for simplicity, but it may actually also capture shifts in the demand for the product.

\(^8\)The intuition behind this definition is that labor leverage captures the extent to which productivity or demand shocks are transformed into operating income shocks. We subtract one so that our measure is zero when there is no amplification. Note that the definition of labor leverage in this setting is analogous to the definition of the broader operating leverage (e.g., see Garcia-Feijoo and Jorgensen (2010)). The reason is that, in our setting, only labor leads to operating leverage. In the Appendix we briefly discuss the case in which the firm is also subject to fixed operating costs to illustrate how the definition of labor leverage is nested within the broader definition of operating leverage.
Proposition 1 (Labor Leverage)

For a constant-returns-to-scale production function, labor leverage is given by

\[
\ell \equiv \frac{d\Delta \pi / d\Delta x}{d\Delta y / d\Delta x} - 1 = \frac{(1 - \gamma t) \frac{\Delta \omega t}{\Delta x t} \left(1 - \frac{\Delta \omega t}{\Delta x t}\right)}{1 + \gamma t \frac{\Delta \omega t}{\Delta x t} \left(1 - \frac{\Delta \omega t}{\Delta x t}\right)},
\]

(3)

where \(\gamma_t \equiv \frac{F_K[K_t, L_t]}{F_L[K_t, L_t]}\) is the elasticity of substitution between labor and capital, \(S \equiv \frac{LW}{Y}\) is the labor share, and lower-case variables are expressed in logs (e.g., \(\Delta x_t \equiv \log\frac{X_t}{X_{t-1}}\)).

Proposition (1) shows that labor leverage is a function of the firm’s labor share, the elasticity of substitution of capital and labor, and the response of wages to productivity changes. In particular, note that if wages respond one-for-one with productivity (i.e., \(\frac{\Delta \omega t}{\Delta x t} = 1\)), then all firms have zero labor leverage. Hence, smooth wages are a necessary condition for labor leverage to exist.

The following assumptions are necessary and sufficient for the existence of strictly positive labor leverage in our setting:

Assumption 1 (Smoothness of Wages and Strict Complementarity of Labor and Capital)

a. Wages are smooth relative to productivity: \(\frac{\Delta \omega t}{\Delta x t} < 1\).

b. The elasticity of substitution between labor and capital is less than one: \(\gamma_t < 1\).

It is common to assume a Cobb-Douglas production function, \(F(K, L) = K^\alpha L^{1-\alpha}\). In this case, labor share is constant, and as a result profits are a constant share of output, \(\Pi = (1 - \alpha)Y\); hence the elasticity of profits equals the elasticity of value added, so that labor leverage \(\ell = 0\). However, as the next proposition shows, this case turns out to be knife-edged (and, we will argue later, not empirically relevant).

The proposition that follows shows that under assumption 1, the labor share is a valid proxy for labor leverage.

Proposition 2 (Labor Leverage and Labor Share)

Assumption 1 implies:

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\(9\)The subscripts \(K\) and \(L\) denote partial derivatives with respect to labor and capital. The proposition follows from the fact that \(\frac{d\Delta \pi / d\Delta x}{d\Delta y / d\Delta x} = \frac{\Delta \omega t}{\Delta x t} \left(1 + \frac{\Delta \omega t}{\Delta x t}\right) - 1\), and the use of the envelope condition on the firm profit maximization problem.
a. The existence of labor-induced operating leverage: \( \frac{\partial \Delta \pi_t}{\partial \Delta x_t} > 1 \), or \( \ell > 0 \),

b. Labor-induced operating leverage increasing in labor share: \( \frac{\partial \left( \frac{\partial \Delta \pi_t}{\partial \Delta x_t} \right)}{\partial S_t} > 0 \), i.e. \( \frac{\partial \ell}{\partial S} > 0 \).

The corollary below shows how the capital-labor elasticity of substitution is related to the elasticities of value added growth and operating profit growth to shocks. It provides a simple way to verify if the data imply an elasticity above or below unity by comparing these elasticities.

**Corollary 1** (Useful Relation Involving Capital-Labor Elasticity of Substitution)
The elasticities of value added growth and operating profits growth to shocks are linearly related through the elasticity of substitution between labor and capital, as given by

\[
\frac{\partial \Delta y_t}{\partial \Delta x_t} - 1 = \gamma_t \left( \frac{\partial \Delta \pi_t}{\partial \Delta x_t} - 1 \right).
\]

So far, the discussion shows that labor leverage makes operating profits relatively more sensitive to shocks. In order for labor leverage to also lead to higher expected returns, we should consider the relative systematic risk exposure of TFP \( X \) and wages \( W \). For simplicity, here we make the additional simplifying assumptions that there are only two periods and that the economy has a single source of priced risk.\(^\text{10}\) Let \( M \) denote the value of an asset that is only exposed to priced risk and that has a risk loading \( \beta_M = 1 \). Let \( \beta^X_t \equiv \frac{\partial \Delta X_t}{\partial \Delta m_t} \) and \( \beta^W_t \equiv \frac{\partial \Delta W_t}{\partial \Delta m_t} \) denote the systematic risk loadings of portfolios of securities that perfectly replicate TFP growth and wage growth.

**Assumption 2** (Positive and high systematic risk loading of TFP relative to wages)
\( \beta^X_t > 0 \) and \( \beta^X_t > \beta^W_t \).

The proposition below shows that Assumption 2 implies that asset betas are increasing in labor share.

**Proposition 3** (Systematic Risk Exposure and Labor Share)

a. **Cash flow beta:** \( \beta_t = \frac{\partial \Delta \pi_t}{\partial \Delta x_t} \frac{\partial \Delta x_t}{\partial \Delta m_t} + \frac{\partial \Delta \pi_t}{\partial \Delta w_t} \frac{\partial \Delta w_t}{\partial \Delta m_t} = \beta^X_t + \frac{S_t}{1-S_t} \left( \beta^X_t - \beta^W_t \right) \).

b. Assumption 2 implies that \( \frac{\partial \beta_t}{\partial S_t} > 0 \).

\(^\text{10}\) We chose the two-period setting simply because it is very tractable: In this particular case, equity betas equal cash-flow betas. We relax this assumption in the dynamic production-based model presented at the end of this paper.
2 Empirical Evidence

We first summarize the testable predictions of our model. We then discuss how we construct the labor share variables. We next present evidence in favor of our key assumptions, and finally we present evidence consistent with our testable implications.

2.1 Testable Predictions

The main empirical implications of the theoretical framework presented in the previous section are that (1) Firms with high labor share exhibit higher sensitivity of cash flows to aggregate shocks (Proposition (2)), and (2) firms with high labor shares have higher expected returns (Proposition (3)).

2.2 Measurement of Labor Share and Summary Statistics

We construct three measures of labor share for our empirical analysis. These measures have different strengths and weaknesses. Our first measure, which is simply denoted \( \text{labor share} \) (hereafter \( LS \)), is the ratio of labor costs to value added. It is defined from Compustat items as follows:

\[
LS_{it} \equiv \frac{XLR_{it}}{OIBDP_{it} + XLR_{it} + \Delta INVFG_{it-1,t}},
\]

where \( XLR \) is the Compustat variable \( \text{Staff Expense – Total} \) (which we use as a proxy for labor costs), \( OIBDP \) is the Compustat variable \( \text{Operating Income Before Depreciation} \), and \( \Delta INVFG_{it-1,t} \equiv INVFG_{it} - INVFG_{it-1} \) is the change in the Compustat variable \( \text{Inventories – Finished Goods} \). We include the change in inventories of final goods to make the empirical measure consistent with the theoretical one. The reason is that, unlike in our model, some of the goods produced over a given year are not sold during that year and, likewise, a portion of the goods sold by the firm in a given year were produced in previous years.\(^{11}\)

Our second empirical measure of labor share is denoted \textit{extended labor share} (hereafter \textit{ELS}). This second measure addresses the concern that the variable \( XLR \) and thus \( LS \) are only available

\(^{11}\)We set \( \Delta INVFG_{it} \) to 0 when either \( INVFG_{it} \) or \( INVFG_{it-1} \) are missing. The results presented in the paper are qualitatively unaffected by excluding the change in inventories from the measure of labor share.
for roughly 12% of firm-year observations in our sample. \( ELS \) is defined as follows:

\[
ELS_{it} = \begin{cases} 
LS_{it} & \text{if } XLR \text{ is non-missing} \\
\frac{LABEX_{it}}{OIBDP_{it} + LABEX_{it} + \Delta INVFG_{it-1}} & \text{if } XLR \text{ is missing,}
\end{cases}
\]

(5)

where \( LABEX \) is a constructed variable defined as the product of the Compustat variable \( EMP \) (Number of Employees) and the average annual labor compensation per employee in the industry during that year. We estimate the average labor compensation per employee as the average ratio of \( XLR \) and \( EMP \) in the industry, calculated using the firms that do report \( XLR \).

Our third empirical measure of labor share, which is constructed with data from the U.S. Census, is denoted Census-based labor share (hereafter \( CLS \)). The \( CLS \) measure is defined as

\[
CLS_{it} = \frac{SW_{it} + LC_{it}}{VA_{it}},
\]

(6)

where \( SW \) denotes salaries and wages, \( LC \) ancillary labor costs such as employer-side social security contributions and contributions to retirement and health insurance plans. \( VA \) denotes the value added which is computed as sales less inventory investment, resales, expenses for intermediate inputs and services as well as energy and electricity inputs. One advantage of \( CLS \) relative to \( LS \) and \( ELS \) is that the Census data used in its construction are high-quality measurements of employment and labor compensation. Another advantage is that it covers firms that are not publicly listed. On the other hand, a limitation of the \( CLS \) measure is that it only covers firms in manufacturing industries. We set \( LS \), \( ELS \), and \( CLS \) as missing if these are negative or greater than one. We provide in the appendix more details about the U.S. Census data used, about the procedure used to match Census data and Compustat data, and about the construction of the \( CLS \) measure.

Overall, we find that \( LS \) and \( ELS \) have correlations with \( CLS \) that are above 0.5 and that are highly statistically significant.\(^{13}\) Moreover, as we show in the remainder of this section, the empirical findings in this paper are consistent across our three measures. These facts are supporting evidence for the validity of the \( LS \) and \( ELS \) measures. We interpret this validating evidence for \( LS \) and \( ELS \) as a contribution that should encourage researchers with no access to confidential Census data who wish to measure the labor share to use \( LS \) or \( ELS \).

\(^{12}\)We use the Fama-French 17-industry classification in the construction of the \( ELS \) measure.

\(^{13}\)See appendix for details.
Table I, Panels A and B, report time-series averages of median characteristics for portfolios of firms sorted on \( LS \) and \( ELS \), respectively. Columns 1a and 1b of Panel A are identical by construction, since \( ELS \) is defined as \( LS \) in the subsample of firms where the latter is nonmissing. The fact that these two columns are quite similar in Panel B as well suggests that the median of \( ELS \) conditional on missing \( LS \) is not significantly different from the median of \( ELS \) conditional on non-missing \( LS \). Column 2 reports that the number of employees per unit of plant, property, and equipment (PPE) (which represents an additional measure of labor intensity used in the literature) is increasing in both \( LS \) and \( ELS \).

Columns 3 to 9 of Table I, Panels A and B, show how firm characteristics vary across labor market quintiles. High labor share firms tend to have higher book-to-market ratios than low labor share firms. Table I also shows a negative relation between labor share and both the market value of equity and the book value of assets. The negative trend in the market value of equity is consistent with the hypothesized greater riskiness of high labor share firms. A possible explanation for the negative trend in asset values is a downward bias in asset value reporting, in particular since high labor share firms are both less capital intensive and have less tangible assets. Consistent with a reporting bias, the panels report that the value of organizational capital, which is not considered in a firm’s financial reports, is increasing in labor share. Profitability ratios and (to some extent) financial leverage ratios seem fairly unrelated to labor share. All these patterns are qualitatively similar across our two measures of labor share.

Table I, Panel C, reports time-series averages of \( average \) characteristics of portfolios sorted on \( CLS \) in the matched Compustat–Census sample. Columns 1a–1c show that the three measures are monotonically increasing across the quintiles, which is consistent with Table A–1, which shows a positive and significant correlation between \( CLS \) and the Compustat-based measures. The general trends in the values of the statistics presented in columns 2–9 of Panel C are consistent with the trends in the corresponding columns of Panels A and B. One notable difference is that the average tangibility in Panel C is more homogeneous across quintiles than in Panels A and B, possibly due to the fact that matched Compustat–Census sample solely covers manufacturing industries.

\[<< \text{Table I here} >>\]

\[^{14}\text{See Damodaran (2011) for a discussion of the relation between intangibles and a bias in asset value reporting.}\]

\[^{15}\text{We report averages and not medians in Panel C because U.S. Census confidentiality guidelines do not allow us to calculate medians.}\]
2.3 Evidence for the Sufficient Conditions Underlying Labor Leverage

As discussed in the introduction, there is ample evidence in the literature for the strict capital-labor complementarity.\textsuperscript{16} The previous section shows that this is one of the sufficient conditions required for the existence of the labor leverage mechanism. In this section, we present empirical evidence consistent with the additional conditions that ensure the existence of the labor leverage mechanism and for its relevance for asset pricing: the smoothness of labor costs and the greater cyclicality of TFP relative to wages and labor costs.

2.3.1 Evidence for Labor Cost Smoothness

Table II reports aggregate statistics that support the hypothesis that wages are smoother and less procyclical than output, profits, and TFP. The table shows that the volatility of the growth rate of before-tax profits is 3.54 times the volatility of the growth rate of GDP, and the slope coefficient in a regression of profit growth on GDP growth, used as a proxy for procyclicality, is 2.22. On the other hand, the volatility of real wage growth is 0.51 times that of GDP growth, thus significantly smoother than profits. Moreover, the slope coefficient of wages on GDP growth is only 0.14, which supports the assumption that wages are less procyclical than profits. TFP is slightly more volatile (volatility 0.57 times that of GDP growth) and significantly more procyclical (slope coefficient of TFP growth on GDP growth is 0.49) than wages.\textsuperscript{17}

\textasciitilde\textasciitilde Table II here \textasciitilde\textasciitilde

Next, we investigate the elasticity of total labor costs to changes in sales directly. The advantage of analyzing labor costs is that we can conduct the analysis at the firm level. Table III, \textsuperscript{16}See León-Ledesma et al. (2010) and Klump et al. (2012), among others, for evidence that the capital-labor elasticity of substitution is lower than one. In an accompanying Online Appendix, we provide additional evidence that the elasticity of substitution between capital and labor is strictly lower than one, which is consistent with this large body of literature in economics.

\textsuperscript{17}The GDP growth series is taken from Table 1.1.3 of the National Income and Product Accounts of the Bureau of Economic Analysis (www.bea.gov). The real wage series and total factor productivity growth series are annualized, based on the quarterly seasonally adjusted series from the Bureau of Labor Statistics Major Sector Productivity and Costs program (www.bls.gov/lpc). The series cover the non-farm business sector. Following Arias, Hansen, and Ohanian (2007), we compute TFP growth as $\Delta \log TFP = \Delta \log Y - \frac{2}{3} \Delta \log H$, where $\Delta \log Y$ is the real output series and $\log H$ is the hours of all persons series. The real wage series is real hourly compensation. This measure is based on the BEA estimates for labor compensation, and it includes benefits. As a result, our measures of real wages and productivity are comparable in sectoral coverage and in construction.
Panel A shows cost elasticity estimates based on Compustat data. Panel A shows that, for each dollar change in sales, staff expenses change 9¢ while all other operating costs (i.e., the sum of costs of goods sold and sales, general, and administrative expenses minus staff expenses) change 72¢. Panel A also shows that for each percentage point change in sales, staff expenses change by 0.43%, which is less than half of the change in all operating expenses (1.07%) and less than a third of that of non-labor operating expenses (1.46%). Table III, Panel B, shows the results of a similar estimation procedure using establishment-level U.S. Census data. The Census data used does not allow for the construction of variables that are fully aligned with those used in Panel A. Differences in variable definitions notwithstanding, the results in Panel B are qualitatively similar to the results in Panel A confirm that labor expenses are significantly more inelastic than other operating expenses. A one dollar increase in sales leads to a 3¢ change in labor compensation, a 84¢ change in non-labor non-SG&A operating expenses, and a 86¢ change in the sum of operating expenses available in the sample. Panel B also shows that for each percentage point change in sales, labor compensation changes by 0.69%, which is lower than the percentage change in all operating expenses available in the sample (0.89%), and also less than non-labor non-SG&A operating expenses (0.99%). Overall, the findings in Table III support the hypothesis that labor costs are significantly less elastic than other operating costs, which is consistent with the existence of the proposed labor leverage mechanism.

<< Table III here >>

2.3.2 Evidence for the Countercyclicality of Labor Shares

The previous section shows that labor costs are relatively smoother than output and other types of costs and that TFP is more procyclical than wages. This section takes a step forward and investigates the cyclical properties of labor shares. The cyclicity of labor share underlies the relation between labor leverage and expected returns. In particular, countercyclical labor shares are consistent with a positive relation between labor leverage and systematic risk loadings and thus with a positive relation between labor leverage and expected returns. In order to establish the

\[\text{For instance, we do not have access to non-labor SG&A costs.}\]
cyclicality of labor shares, we run the following panel data regressions with fixed effects:

\[ S_{it}^g = \beta_{0i} + \beta_1 x_t^g + \epsilon_{it} \]  

(7)

where \( S_{it}^g \) is the annual percentage growth in the measure of labor share under consideration (\( LS \), \( ELS \), and \( CLS \)) and \( x_t^g \) is the percentage growth in our business cycle proxy (GDP growth, TFP growth, or market returns). The subscript \( i \) in the intercept of the regression shown in Equation (7) denotes firm-fixed effects in specifications with \( LS \) and \( ELS \) and establishment-fixed effects in specifications with \( CLS \).

Table IV documents the estimates from regression (7) in our samples from Compustat and from the Census. The specifications based on Compustat data use the \( LS \) and \( ELS \) measures and are conducted at the firm level. The specifications based on Census data use \( CLS \) and are conducted at the firm level. The table shows that our three measures of labor share are time-varying and countercyclical. This result is consistent with the previous finding that wages are smooth and that the capital-labor elasticity of substitution is less than one, since in that case labor share and productivity are negatively related.

<< Table IV here >>

### 2.4 Sensitivity of Profits to Macroeconomic Shocks

In this section, we present direct evidence for the existence of the labor leverage mechanism proposed in this paper. In particular, we show that high labor share firms are exposed to a higher level of operating leverage. We start by noting that the telltale sign of a high level of operating leverage—labor induced or otherwise—is a high sensitivity of operating profits to exogenous shocks to a firm’s (or establishment’s) sales or output. Hence, we investigate whether, as implied by Proposition (2), labor share is positively related to the sensitivity of operating profits to shocks.

To test this hypothesis, we run the following panel data regressions with interaction terms:

\[ prof_{it}^g = \beta_{0i} + \beta_1 x_t^g + \beta_2 x_t^g S_{i,t-1} + \beta_3 S_{i,t-1} + \epsilon_{it} \]  

(8)

where \( x \) is the proxy aggregate shock (GDP growth, TFP growth, or market returns), \( prof_{it}^g \) is the percentage growth of operating profit before interest and depreciation, and \( S \) is the proxy of labor
share under consideration, $LS$, $ELS$, or $CLS$. The proxy $S$ is lagged one year to address the concern of simultaneity.\footnote{As presented in Table IV, labor share is negatively correlated with contemporaneous aggregate shocks.} The subscript $i$ in the intercept of the regression shown in Equation (8) denotes firm-fixed effects in all specifications that involve Compustat data and establishment-fixed effects in specifications based solely on Census data.

Table V, Panel A, presents the results of tests based on Compustat data, which use firm-level $LS$ and $ELS$ measures of labor share. The first three specifications in Panel B show the results of tests based on the merged Compustat-Census sample, which use firm-level $CLS$ as measure of labor share. The last three columns of the panel present results of tests based solely on Census data, which use establishment-level $CLS$.

The results across all 12 specifications shown in Table V are quite consistent. Profit growth are positively exposed to aggregate shocks, and this sensitivity increases in labor share. The magnitudes are quantitatively significant; for instance, the average difference in $LS$ between the high and low $LS$ portfolio is 0.50; this implies that the difference in profit sensitivity to GDP growth is $0.5 \times 1.15 = 0.57$. This spread is economically significant: the typical firm in the low $LS$ portfolio has a sensitivity of $1.96 + 0.33 \times 1.15 = 2.34$ whereas the typical firm in the high $LS$ portfolio has a sensitivity $1.96 + 0.83 \times 1.15 = 2.91$. Similar conclusions can be obtained by considering the other specifications.

These findings show that operating profits of labor intensive firms are more sensitive to aggregate shocks, and support the economic significance of the labor-induced operating leverage mechanism. These results can also be interpreted as additional validation for the three proxies for labor leverage proposed in this paper.

\[<< \text{Table V here} >>\]

### 2.5 Expected Returns

Our theoretical model predicts that, under relatively mild assumptions, expected returns should be increasing in labor share. In this section, we investigate this prediction and explore the empirical relation between labor share and expected returns. To address the challenge that expected returns are not observable, we use two different types of proxies for them: realized stock returns and stock return loadings on risk factors (i.e., betas).
2.5.1 Realized Returns

Table VI presents average post-ranking annual excess equity returns of quintile-portfolios of firms sorted on LS, ELS, and CLS, as well as a zero-investment portfolio (H-L portfolio). The labor share measures are lagged by one year to avoid the use of information not available to market participants on a given date.\(^{20}\) H-L is a yearly rebalanced portfolio that is long stocks in the highest labor share quintile and short stocks in the lowest labor share quintile. The average excess returns of the H-L portfolios range between 4.36% and 6.41% per year for equally-weighted returns, depending on the labor share measure used, and between 3.48% and 3.94% per year for value-weighted returns. The findings presented in Table VI are consistent with the existence of the labor leverage mechanism and with its economic relevance for asset prices.

\[<< \text{Table VI here} >>\]

Table VII provides additional supporting evidence for this finding. The panel reports results of panel data regressions of annual returns on the lagged measures LS, ELS, and CLS.\(^{21}\) All independent variables are standardized so that they have a mean of 0 and a standard deviation of 1 in the sample. This standardization allows for a more direct comparison of the slopes across specifications. A one standard deviation cross-sectional increase in LS, ELS, and CLS leads to a cross-sectional increase in annual returns of 1.24%, 0.64%, and 0.82%, respectively, after controlling for financial leverage and the size of the asset base. We do not control for book-to-market ratio and market value, since, as we show later in the structural model, these variables subsume the effect of operating leverage on expected returns. Taken together, these results confirm the findings from Table VI and further support the economic significance of the relation between labor leverage and expected returns.

\[<< \text{Table VII here} >>\]

\(^{20}\)To be absolutely certain our analysis excludes future information, we also run one specification with two lags which yields similar results. Rows in Table VI with CLS are lagged by two years as Census results were disclosed prior to deciding to report results based on a one-year lag; results based on a one-year lag are similar, however.

\(^{21}\)We lag right-hand side variables by two years to avoid the use of look-ahead information in the regressions in specifications involving CLS. We use the same lag throughout to allow comparability across specifications.
2.5.2 Risk Factor Loadings

Under a rational expectation and full information setting, realized returns are an unbiased, albeit noisy, proxy for unobservable expected returns. In this section, we use loadings on traditional risk factors (i.e., risk factor betas) as an alternative proxy for expected returns. Note, however, that the use of empirical estimates of risk factor betas as proxies for expected returns does not imply that this paper takes a stand on whether the empirical implementations of the CAPM or other traditional asset pricing models are well specified. In fact, our structural model, presented in the following section, is agnostic in regard to the source of systematic risk in the economy, which is represented by $dZ^\Lambda$ in Equation (9). The only additional required assumption in this section is that the empirical risk factors are merely correlated to the true source(s) of risk in the economy. Under this assumption, empirical estimates of risk factor betas will be positively related to expected returns. And in that case, the hypothesis that expected returns are increasing in labor share is equivalent to the hypothesis that systematic risk loadings are increasing in labor share.

Table VIII reports the average conditional betas constructed as in Lewellen and Nagel (2006) for portfolios of firms sorted on our measures of labor share, $LS$ (Panel A), $ELS$ (Panel B), and $CLS$ (Panel C). The table presents results for betas with respect to six different proxies for aggregate risk. The first three proxies for aggregate risk are the returns of the market portfolio (MKT), the small-minus-big size factor (SMB), and the high-minus-low value factor (HML), all from Fama and French (1993). The table also includes betas with respect to the real macro variables used and described in Table II: GDP growth, TFP growth, and real wage growth.

Overall, the three panels of Table VIII show that the betas with respect to the six proxies for aggregate risk are increasing in magnitude across the labor share quintiles. The difference in the betas between the highest and lowest labor share quintiles is positive for all factors, except for HML, albeit the difference is not always statistically significant at standard confidence levels. The fact that HML betas are negative and increasing in magnitude across the $LS$-based portfolios, although not $ELS$-based and $CLS$-based portfolios, is also consistent with the proposed mechanism, since it implies that loadings on $HML$ are positive and increasing. In fact, Kogan and Papanikolaou

\footnote{Despite the historical popularity and intuitive appeal of using realized returns as proxies for expected returns, an important concern (discussed in detail by Elton (1999)) is that average realized returns are noisy and possibly biased proxies for expected returns.}

\footnote{Discuss construction of Lewellen and Nagel}
(2014) suggest that -HML is a risk factor that is related to investment-specific (IST) shocks and thus carries a negative price of risk. Overall, the evidence from tests based on risk factor loading is not as strong as the evidence from Table VI and VII, but it is nevertheless consistent with the labor leverage mechanism.

$$\text{Table VIII here}$$

3 Model

The results from the previous section uncover an empirical link between a firm’s labor share and its expected return. We now rationalize those results by replicating them via a structural partial equilibrium model. The model is a specific application of the more general framework presented in Section 1. Some additional structure allows us to estimate moments for quantities and prices and compare them to the empirical results from Section 2. We show that this simple model can explain the main findings presented in Section 2, further highlighting the role of labor leverage in firms’ cash flow dynamics and, consequently, in their expected returns.

3.1 Setup

We take the stochastic discount factor (SDF) as exogenous. The dynamics of the SDF, which we denote by $\Lambda$, are given by

$$\frac{d\Lambda_t}{\Lambda_t} = -rdt - \eta dZ^\Lambda,$$

where $r > 0$ is the instantaneous risk-free rate, $dZ^\Lambda$ is a Wiener process that represents the single source of systematic risk in the economy, and $\eta$ represents the aggregate price of risk.

We assume perfect competition, so that the firm takes as given both its output price and the real wage it must pay its employees. The dynamics of the real wage $W$ are given by

---

24IST shocks are shocks that affect the value of investment opportunities but not the value of assets in place. See Papanikolaou (2011); Garleanu, Panageas, and Yu (2012); and Kogan and Papanikolaou (2014) for a discussion of the asset pricing implications of IST shocks.
\[ \frac{dW_t}{W_t} = \mu_W dt + \sigma_W \rho_W dZ^W_t + \sigma_W \sqrt{1 - \rho_W^2} dZ^W_t, \tag{10} \]

where \( dZ^W_t \) is a Wiener process orthogonal to \( dZ^\Lambda_t \) (i.e., \( \text{E}[dZ^W_t dZ^\Lambda_t] = 0 \)); \( \mu_W \) and \( \sigma_W \) are the drift and volatility of the wage growth process, respectively; and \( \rho_W \) is the priced portion of the wage growth risk.

The firm’s productive technology is represented by a constant elasticity of substitution (CES) production function. Value added is given by

\[ Y_t = X_t \left( \alpha L_t^\rho + (1 - \alpha) K_t^\rho \right)^{\frac{1}{\rho}}, \tag{11} \]

where \( L \) and \( K \) denote the labor and capital employed in production, \( \alpha \in (0, 1) \) captures the relative importance of labor in total production, \( X \) denotes the level of total factor productivity (TFP), and the parameter \( \rho \) determines the elasticity of substitution between capital and labor, \( \gamma \equiv \frac{1}{1 - \rho} \). The limit \( \rho \to -\infty \) represents the case in which capital and labor are perfect complements, while the other extreme case, \( \rho = 1 \), represents the case in which capital and labor are perfect substitutes.

The case in which \( \rho \to 0 \) represents the Cobb-Douglas production function. We focus on the empirically relevant case in which labor and capital are strictly complements (\( \rho < 0 \)).\(^{25}\) To focus on the implications of the labor share for firm risk, we abstract away from investment and depreciation so that capital \( K \) is fixed.

It is convenient to further decompose the firm’s TFP \( X \) into two components: aggregate TFP \( (X^\Lambda) \) and the idiosyncratic component of TFP \( (X^I) \), such that \( X = X^\Lambda X^I \). Aggregate TFP \( X^\Lambda \) follows the diffusion process

\[ \frac{dX^\Lambda_t}{X^\Lambda_t} = \mu_X dt + \sigma_X \rho dZ^\Lambda_t, \tag{12} \]

\(^{25}\)Multiple studies estimate values for the elasticity of substitution between capital and labor \( \gamma \) to be .7 or lower, which implies values for \( \rho \) lower than -0.4. See Klump et al. (2012) and references therein to find studies that support the strict complementarity between labor and capital in a number of countries around the world. See Oberfield and Raval (2014) for a recent study about the US manufacturing sector that finds an average elasticity of .5. As demonstrated in that paper (and following the insight of Houthakker (1955)), the micro-level elasticity of substitution (which is relevant for our mechanism) may differ substantially from the macro-level elasticity of substitution.
while the idiosyncratic component of TFP $X^i$ follows the diffusion process

$$\frac{dX^i}{X^i} = \sigma_X \sqrt{1 - \rho_X^2} dZ^X,$$

(13)

where $dZ^X$ is orthogonal to both $dZ^\Lambda$ and $dZ^W$ (i.e., $E[dZ^X dZ^\Lambda] = 0$ and $E[dZ^X dZ^W] = 0$).

In addition to idiosyncratic TFP shocks, each firm faces a risk of death, in which the productivity and value of the firm both fall to zero. Firm death is modeled as a Poisson event with mean arrival rate $\lambda$.

Profit maximization drives the firm to set its labor demand $L^D$ such that the marginal profitability of labor ($\frac{dY}{dL}$) is equated to the real wage ($W$). Solving out yields the following Labor demand $L^D$:

$$L^D_t = (1 - \alpha)^{1/\rho} \left( \frac{W_t}{\alpha X_t} \right)^{\frac{\rho}{\rho - 1}} - \alpha.$$

(14)

Equation (14) implies that, consistent with intuition, the firm will demand more labor when its productivity is high relative to the real wage. In what follows, we always assume that the firm sets labor optimally.

We define labor share $S$ as the ratio of labor costs to value added, $S \equiv \frac{L^D W}{Y}$. Intuitively, labor share is a measure of how value added is split between workers and the firm (capital) owners. Using Ito’s Lemma we find the dynamics of $S$:

$$\frac{dS_t}{S_t} = \mu_S dt + \sigma_{s\Lambda} dZ^\Lambda_t + \sigma_{sW} dZ^W_t + \sigma_{sX} dZ^X_t,$$

(15)

where:

$$\mu_S \equiv -\left( \frac{\rho}{\rho - 1} \right) (\mu_a - \mu_w - \sigma^2_a) + \left( \frac{\rho}{\rho - 1} \right)^2 \left( \frac{\sigma^2_a}{2\rho} - \rho_a \rho_w \sigma_w \sigma_a + \frac{\sigma^2_w}{2\rho} \right),$$

(15a)

$$\sigma_{s\Lambda} \equiv -\left( \frac{\rho}{\rho - 1} \right) (\rho_a \sigma_a - \rho_w \sigma_w),$$

(15b)

$$\sigma_{sW} \equiv \left( \frac{\rho}{\rho - 1} \right) \sigma_w \sqrt{1 - \rho^2_w},$$

(15c)

$$\sigma_{sX} \equiv -\left( \frac{\rho}{\rho - 1} \right) \sigma_X \sqrt{1 - \rho^2_X}.$$

(15d)

The purpose of this additional source of idiosyncratic shocks is solely to stabilize the distribution of firms.
Equation (15) implies that labor share is affected differently by shocks to wages and shocks to productivity. In the empirically relevant case in which labor and capital are strictly complements \((\rho < 0)\), labor share \(S\) is decreasing in idiosyncratic productivity (i.e., \(\sigma_{SX} < 0\)). Equation (15) also shows that, despite the fact that labor demand decreases with wages, the labor share \(S\) is increasing in wages (i.e., \(\sigma_{SW} > 0\)) because the price effect dominates the quantity effect. Figure 1 illustrates the negative relationship between labor share and idiosyncratic productivity and shows the positive relationship between labor share and wages. Finally, the effect of aggregate productivity (i.e., the priced shock \(\lambda\)) on the labor share reflects a combination of the two effects described above. On the one hand, higher aggregate productivity leads to a lower labor share; but on the other hand, higher aggregate productivity is associated with a higher real wage (according to \(\rho_W\)), which increases the labor share. The overall effect is negative (i.e., \(\sigma_{SA} < 0\)), provided that real wage response is not too large, which is the empirically relevant case.

Fig. 1. Determinants of labor share. Labor share as a function of productivity and wages in the production model. The figure shows the numerical solution for the firm’s labor share as a function of productivity and wages. The left panel shows that labor share is decreasing in productivity. The right panel shows that labor share is increasing in economy-wide wages. The chosen values for \(\rho\) result in elasticities of substitution of .5 and .7, values in the range of what many empirical studies find for the elasticity of substitution between capital and labor. Parameter values used in numerical solution: \(\alpha = 0.67\), \(W = 0.5\) (left panel), and \(X = 1\) (right panel).

\(^{27}\)For completeness, it is worth mentioning the two cases that are not considered in this paper. Labor share is constant in the standard Cobb-Douglas production function (i.e., when \(\rho \to 0\)) and equals \(\alpha\). When labor and capital are strictly substitutes (i.e., when \(\rho > 0\), labor share is decreasing in wages and increasing in productivity.

\(^{28}\)A labor share greater than unity is possible in theory and would simply imply negative operating profits. As we discuss later, shareholders will choose to temporarily suspend operations in such states, so that labor share is effectively bounded by 1 for active firms.
Operating profits are defined as the residual cash flows of the firm after labor expenses are paid, \( \Pi \equiv Y - LW \). We assume that firms can frictionlessly suspend and resume production (and thus operating costs) over time. Operating profits under the optimal labor demand can then be expressed as a function of productivity \( X \) and labor share \( S \):

\[
\Pi_t = \begin{cases} 
(1 - \alpha) \frac{1}{\rho} X_t K_t (1 - S_t) \frac{\rho - 1}{\rho}, & \text{if } S_t < 1, \\
0, & \text{if } S_t \geq 1,
\end{cases}
\]

where the second region reflects the fact that the firm will optimally suspend production before operating profits become negative, which happens when \( S \geq 1 \). Figure 2 shows the negative relation between labor share and operating profits (holding productivity \( X \) fixed). For instance, an increase in the real wage leads to an increase in labor share and a decrease in operating profits. On the other hand, higher productivity increases operating profits by increasing total output directly (according to Equation (16)). The dynamics of profit growth are given by:

\[
\frac{d\Pi_t}{\Pi_t} = \mu_{\Pi}[S_t] dt + \sigma_{\Pi_{\lambda}}[S_t] dZ^{\lambda} + \sigma_{\Pi_{W}}[S_t] dZ^{W} + \sigma_{\Pi_{X}}[S_t] dZ^{X},
\]

where:

\[
\mu_{\Pi}[S_t] \equiv \left( \frac{1}{1 - S_t} \right) \left( \mu_X - S_t \mu_W + \left( \frac{\rho}{1 - \rho} \right) \left( \frac{S_t}{1 - S_t} \right) \left( \frac{\sigma_X^2}{2} - \rho \sigma_X \sigma_W + \frac{\sigma_W^2}{2} \right) \right),
\]

\[
\sigma_{\Pi_{\lambda}}[S_t] \equiv \left( \frac{1}{1 - S_t} \right) \left( \rho_X \sigma_X - \rho_W \sigma_W S_t \right),
\]

\[
\sigma_{\Pi_{W}}[S_t] \equiv - \left( \frac{S_t}{1 - S_t} \right) \left( \sqrt{1 - \rho_X^2 \sigma_X} \right), \quad \text{and}
\]

\[
\sigma_{\Pi_{X}}[S_t] \equiv \left( \frac{1}{1 - S_t} \right) \left( \sqrt{1 - \rho_W^2 \sigma_W} \right).
\]

Equation (17) shows that, since the capital stock is fixed, the dynamics of operating profits follow only from systematic and idiosyncratic TFP shocks and from shocks to the real wage. It also shows that the sensitivity of profit growth to the three shocks (\( dZ^{\lambda}, dZ^{W}, \) and \( dZ^{X} \)) are increasing.

\[\text{---}\]

\[\text{---}\]
in *magnitude* in labor share $S$. This gives rises to the connection between labor share and labor-induced operating leverage, to which we now turn.

![Graph showing the relationship between labor share and operating profits.](image)

**Fig. 2.** Operating profits and labor share. Operating profits a function of labor share in the production model. Parameter values used in numerical solution: $W = 0.5$, $\alpha = 0.67$, $K = 1$, $\sigma_X = 0.2$, $\rho_X = 0.5$, $\sigma_w = 0.05$, and $\rho_w = 0.1$.

### 3.2 Labor Leverage

Having derived the dynamics of cash flows, we can now formalize the labor leverage mechanism. The *traditional* operating leverage arises from the existence of fixed operating expenses. In contrast, the labor leverage mechanism is not based on the existence of fixed costs - labor is fully adjustable. Instead, the labor leverage mechanism is based on the relative smoothness of wages and the imperfect correlation between wages and productivity.

To see this, note that the response of profits to the aggregate productivity shock (i.e., the priced shock $\lambda$) equals \((\frac{1}{1-S}) (\rho_X\sigma_X - \rho_w\sigma_w S)\) according to Equation (17), hence in the special case in which wages respond one-for-one to productivity (i.e., $\rho_X\sigma_X = \rho_w\sigma_w$), the response of operating profits to the shock is the same for all firms: profits respond one-to-one to productivity. In contrast, in the case in which wages respond less than one-for-one to productivity shocks (i.e., $\rho_X\sigma_X > \rho_w\sigma_w$), the response of operating profits to the shock is greater than unity for all firms. Smooth wages lever up cash flow shocks, making operating profits more procyclical. Moreover, this operating leverage effect is larger when the labor share $S$ is larger.
The assumption $\rho_X \sigma_X > \rho_W \sigma_W$ is consistent with standard stylized facts. In aggregate data, corporate profits (or earnings) are highly procyclical and more volatile than total factor productivity (TFP) or GDP. It is well understood that an important reason for this fact is that labor compensation is relatively smooth and weakly correlated with TFP or GDP growth.\footnote{For instance, Longstaff and Piazzesi (2004) hypothesize that the reason for the extreme volatility and procyclicality of corporate earnings is that stockholders are residual claimants to corporate cash flows. Thus, the compensation of workers is a senior claim to cash flows. See also Gomme and Greenwood (1995).}

To quantify the effect of labor share on firm risk amplification, we define two measures of the sensitivity of operating profits to each of its two sources of shocks: productivity and wages. The first is a measure of the sensitivity of cash flow growth to TFP shocks, $\Theta$, which we denote simply as operating leverage. Operating leverage, $\Theta$, can be defined generally (see for instance Donangelo (2014)) as the covariance of equilibrium operating profit growth and TFP growth minus one (i.e., $\Theta \equiv \text{Cov} \left[ \frac{d\Pi}{\Pi}, \frac{dX}{X} \right] / \text{Var} \left[ \frac{dX}{X} \right] - 1$).\footnote{Alternatively, $\Theta$ is defined as the slope of a regression of operating profit growth on TFP growth minus one. The subtraction by 1 is a simple rescaling so that $\Theta$ is 0 when there is no risk amplification in the transmission of shocks.} Given the results of the previous section, operating leverage

$$\Theta[S_t] = \frac{S_t}{1 - S_t} \left( 1 - \frac{\rho_W \rho_X \sigma_W}{\sigma_X} \right).$$

Equation (18) shows that the sensitivity of operating profits to TFP shocks is positive and monotonically increasing in labor share $S$, as long as TFP is more volatile than the component of wage growth correlated with TFP growth.\footnote{We anticipate that the assumption is fairly weak. For instance, we document that aggregate wage growth is less volatile and not highly correlated with aggregate TFP growth.}

This result is summarized in the proposition below:

**Proposition 4 (Monotonic relationship between operating leverage and labor share)**

The condition $\sigma_X > \rho_W \rho_X \sigma_W$ implies that operating leverage is positive and increasing in labor share $S$:

$$\Theta[S_t] > 0 \text{ and } \frac{d\Theta[S_t]}{dS_t} \geq 0.$$ 

Proposition 4 follows directly from Equation (18). The main message of Proposition 4 is that, under strict complementarity of labor and capital, labor share can be used as a proxy for the degree of labor leverage experienced by the firm.

We also define a related measure $\Theta^W$ as the sensitivity of operating profits to changes in
economy-wide wages (i.e., \( \Theta^W \equiv \text{Cov} \left[ \frac{d\Pi}{dW}, \frac{dW}{W} \right] / \text{Var} \left[ \frac{dW}{W} \right] - 1 \)). The measure \( \Theta^W \) is given by

\[
\Theta^W[S_t] = - \frac{1}{1 - S_t} \left( 1 - \frac{\rho_{wX} \sigma_X}{\sigma_w} \right).
\] (19)

Equation (19) shows that the sensitivity of operating profits to wages shocks is negative, and its magnitude is monotonically increasing in labor share \( S \). This result is summarized in the corollary below:

**Corollary 1** (Sensitivity of operating profits to wage shocks)

The condition \( \sigma_X > \rho_{wX} \sigma_w \) implies that the sensitivity of operating profit growth to wage growth is negative and increasing in magnitude in labor share \( S \):

\[
\Theta^W[S_t] < 0 \text{ and } \frac{d\Theta^W[S_t]}{dS_t} \leq 0.
\]

Corollary 19 follows directly from Equation (19).

Figure 3 illustrates the relation of labor share to the exposure of operating profits to the two sources of uncertainty: productivity and wages. The figure shows that the magnitudes of the positive sensitivity of operating profits to productivity and the negative sensitivity of operating profits to wage shocks is increasing in labor share. This effect, which is directly related to labor leverage, is an intuitive result: Higher labor share is related to lower profit margins, which buffer the firm against either type of shocks. Productivity is positively related to operating profits, so that the exposure to productivity shocks is always positive and increasing in labor share. Labor expenses are negatively related to operating profits, so that the exposure to wages shocks is always negative, and its magnitude is increasing in labor share.
Fig. 3. Labor leverage and labor share. Sensitivity of operating profits to productivity and wage shocks in the production model. The figure shows the relation of labor share to the exposure of operating profits to the two sources of uncertainty: productivity and wages. The figure shows that the magnitudes of the positive sensitivity of operating profits to productivity and the negative sensitivity of operating profits to wage shocks is increasing in labor share. Parameter values used in numerical solution: $W = 0.5, \alpha = 0.67, K = 1, \sigma_x = 0.2, \rho_x = 0.5, \sigma_w = 0.05$, and $\rho_w = 0.1$.

### 3.3 Valuation and Expected Returns

In equilibrium, firm value ($V$) equals the value of the discounted stream of optimized operating profits:

$$V_t = E_t \left[ \int_t^\infty \frac{\Lambda_t}{\Lambda^v} \Pi_s ds \right]. \quad (20)$$

Under technical conditions, the solution to Equation (20) exists, and it is given by

$$V_t = (1 - \alpha)^{1/\rho} X K v[S], \quad (21)$$

where $v$ is a monotonically decreasing function of labor share, such that $\lim_{S \to 0} v[S] = 1$ and $\lim_{S \to \infty} v[S] = 0$. The explicit solution is given in the Appendix.

The solution for the firm value is intuitive. First, when labor costs become negligible relative to the value added generated by the firm ($S \to 0$), the value of the firm converges to that of a firm with a perpetual dividend governed by a geometric Brownian motion, in which the current dividend equals $(1 - \alpha)^{1/\rho} AK$. As the cost of labor increases relative to the value added generated by the firm, the dividend falls and, consistently, the value of the firm falls. When labor costs equal the
value added \((S \to 1)\), operating profits are zero, so the firm shuts down production and all firm value arises from the option to resume production when operating profits become positive again. As \(S \to \infty\) the probability that the firm will ever operate again goes to zero, and the value of the firm consequently becomes zero.

The negative relation between labor share and firm value is driven by two complementary channels: a cash flow channel and a discount rate channel. The cash flow channel consists in labor intensive firms having lower operating profits due to higher labor expenses per unit produced (i.e., higher marginal profitability of labor). The discount flow channel is related to the higher loading on systematic risk of a labor-intensive firm relative to a capital-intensive one. Figure 4 illustrates the negative relation between labor share and firm value.

\[
\rho = -1 \quad \rho = -0.5
\]

\[
\begin{array}{c}
\text{Labor Share (S)} \\
\text{Firm Value (V)}
\end{array}
\]

**Fig. 4.** Firm value and labor share. Firm value as a function of labor share in the production model. Parameter values used in numerical solution: \(W = 0.5\), \(\alpha = 0.67\), \(K = 1\), \(\mu_X = 0\), \(\sigma_X = 0.2\), \(\rho_X = 0.5\), \(\mu_W = 0\), \(\sigma_W = 0.05\), \(\rho_W = 0.1\), \(r = 0.02\), \(\eta = 0.5\), and \(\lambda = 0\).

Expected returns are the instantaneous drift of the gains process that reinvests dividends, \(E_t[R_t] \equiv E_t\left[\frac{dV_t + \Pi_t dt}{V_t}\right]\), and are given by:

\[
E_t[R_t] = r - \lambda + \eta \sigma_X \rho_X + S_t \frac{\nu'[S_t]}{\nu[S_t]} \frac{\rho}{1 - \rho} (\rho_X \sigma_X - \rho_W \sigma_W).
\]

We show in the Appendix that \(\nu'(S_t) < 0\) holds for all parameter values where a feasible solution for Equation (21) exists. Thus, Equation (22), in conjunction with our assumption that \(\rho < 0\),
implies that the relationship between risk and labor share depends on the sign of $\rho_X\sigma_X - \rho_W\sigma_W$. This is formalized below:

**Proposition 5 (Asset returns and labor share)**

For $S_t \in (0, 1)$, $\rho_X\sigma_X > \rho_W\sigma_W$ is a sufficient condition for $\frac{d\text{E}[R_t]}{dS_t} \geq 0$.

If the condition is satisfied, wages are less procyclical than productivity, and labor intensive-firms have higher exposure to systematic risk (and narrower profit margins).

Equation (22) shows that the firm’s excess returns over the risk-free rate depends on two sources of priced risk. The first source is a premium paid for the riskiness coming from the covariance between the firm’s productivity and the stochastic discount factor ($\rho_X\sigma_X$). We call this source of risk *productivity risk*. Productivity risk affects expected returns both directly, through its impact on overall productivity, and indirectly, through its impact on the relative productivity of capital and labor. It is this second, indirect, component that depends on the firm’s labor share. The direct impact of productivity risk for an average firm will be positive in good times, as the average firm produces more, or finds that the prices of its products increase. The indirect impact is also positive, since our assumption about complementarity between labor and capital implies that a positive shock to the firm’s productivity will amplify the impact on profits.

The second source of risk captures the firm’s exposure to aggregate wages ($\rho_W\sigma_W$). We call this component the *wage hedge*, as it depends only on the firm’s exposure to wages and will likely *reduce* risk for the average firm. The wage hedge is linked to labor share, since variations in wages will have a larger effect on firms with large labor costs. This component is a hedge because, on average, wages fall in bad times, which is precisely when a firm’s profits are also falling due to systematic decreases in its own productivity.

Combining the two sources of risk—one positive, the other a hedge—delivers the relation between the firm’s labor share and expected returns. This relation will be positive if the firm’s systematic component of productivity is procyclical enough relative to wages. For instance, the systematic risk loadings of a firm whose productivity is uncorrelated with the stochastic discount factor ($\rho_X = 0$) is decreasing in its labor share. This is because, in this case, the hedge effect of wages is uncontested: Wages go up in good times, so profits fall; wages go down in bad times, so the firm’s profits increase.

The hedging impact of wages, though, is muted when the firm’s productivity is sufficiently
procyclical (ρ_Xσ_X > ρ_Wσ_W). In this case, even though wages are a hedge, the procyclical variation in the firm’s sales price dominates, making the firm riskier as its labor share increases.

Figure 5 shows that asset betas are increasing in labor shares. The figure also shows that the positive relation between betas and labor share implies a positive relation between betas and wages and implies a negative relation between betas and productivity. The last panel shows that betas are insensitive to productivity once we control for labor share.

![Figure 5](image-url)

**Fig. 5.** Betas, productivity, wages and labor share. Betas as a function of labor share, productivity, and wages in the production model. Parameter values used in numerical solution: X^I = 1, X^A = 1, W = 0.5, α = 0.67, K = 1, μ_X = 0, σ_X = 0.2, ρ_X = 0.5, μ_W = 0, σ_W = 0.05, ρ_W = 0.1, r = 0.02, η = 0.5, and λ = 0.

### 3.4 Quantitative Analysis of the Model

Our model represents a proof-of-concept for the theory developed in the Section 1. In this section, we take a step further and investigate the quantitative properties of the model via a cali-
bration exercise. By simultaneously simulating the dynamics of many different firms—their labor share, cash flow, valuations, and expected returns endogenously varying over time—we impose discipline on our parameter choice so that relevant moments for the distribution of firms’ characteristics match the data. We can then further analyze the model’s implications for the cross-section of stock returns, as well as validate some of our additional results from the empirical section. We find that, despite its qualitative nature, our model is able to generate results that are consistent with many of our empirical findings.

### 3.4.1 Calibration procedure

The calibration exercise is as follows. We use a given set of parameters to generate time-series paths for 10,000 firms over 1,200 months. Firms are identical at the beginning of each simulation. We record firm characteristics and valuations on the penultimate month, and we record returns and volatilities using changes that occurred between the penultimate month and last month in the simulation. Next, we calculate relevant moments for the distribution of firm characteristics and returns, and perform cross-sectional regressions similar to those conducted in Section 2. We repeat this process 10,000 times and then average the resulting moments and coefficients from the regressions. Finally, we compare the moments used for the calibration with the moments found in the data using a loss function and then use a Simulated Annealing algorithm to find parameters that minimize the value of the loss function.\(^{34}\)

One challenge in the calibration of the model is that the distribution of firm valuations and characteristics is not constant. We deal with this issue in two ways. First, we include a Poisson process for death of firms to the model solution. When a firm dies, it exits the market and it is replaced by a new firm with the same original characteristics that all firms had a time zero. Once we add this feature to the model, long-term distributions will be stationary. Second, the simulated time period is purportedly long to ensure that the distribution of firms becomes stable.

Table IX shows the target moments used in the calibration. We target macroeconomic moments,

\(^{34}\)The loss function is defined as the weighted average of the squared differences between targets model-generated moments. We only use the last year of simulated data in the analysis to ensure we are measuring the heterogeneity that arises only from differences in the idiosyncratic shock paths. The number of firms chosen for the simulation is set so it is at the same order of magnitude of the average number of publicly traded firms in the United States in the last century. The number of simulations is chosen so that the moments obtained from the simulation are stable enough for the optimal-parameter-seeking algorithm to deliver stable results.
firm-level cash flows moments, and firm-level average unlevered stock returns. We choose the macroeconomic moments to ensure that the aggregate behavior of our simulated firms corresponds to well-known aggregate moments of the US economy. In particular, we target the volatilities of GDP, aggregate TFP, and aggregate wage growth. Since covariances are key components of asset prices, we also target the correlations between GDP growth and aggregate TFP growth, the correlation between GDP growth and aggregate wage growth, and the correlation between aggregate TFP growth and aggregate wage growth.

The firm-specific moments we target are those that link labor shares with expected returns through leverage, namely the sensitivity of cash flows to GDP and TFP growth, as well as the change in the sensitivity of cash flows to GDP and TFP growth as a function of labor share.

The asset-pricing moments we target are those that link differences in expected asset returns to labor share. Given that, in the empirical section, we report returns for quintiles of stocks ranked by labor share, we target the average return for the low-labor-share quintile portfolio, the high-labor-share quintile portfolio, as well as the difference in returns between these two portfolios.

Table IX reports the weights attached to each of the moments targeted in the calibration. We give the highest weight to the aggregate volatility of our simulated firms—with half as much weight on their correlations. We assign a high weight to the cross-sectional standard deviation of value-added growth, given the relatively low number of other firm-level moments. We set a relatively low weight to the slope coefficients from the regressions, since these are subject to significantly more serious estimation problems. Finally, we give a relatively high weight to the return of the low-labor-share quintile portfolio to obtain realistic stock returns, and we give a lower weight to the spread in portfolio returns between high and low labor share firms, given that this difference also suffers from potential estimation problems.

3.4.2 Calibration results

Table X shows the resulting parameters that are required to match the moments discussed above. Consider first the implications for the representative technology in the economy; in particular the elasticity of substitution between capital and labor, given the wide attention it has received

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35 Unlevered returns are constructed as $\text{ret}_{\text{un}} = \text{ret} \times (1 - \text{leverage}_{t-1})$. 

30
in the literature. The resulting parameter, .40, is squarely in the range of values obtained by other estimations performed with very different methodologies, as discussed in the introduction.

The calibration delivers the expected results for the observed shocks and drift for wage growth and productivity growth in the U.S., but it yields interesting results related to unobservable variables: in particular, the priced portion of wage and productivity shocks. The implied priced portion of wage shocks with the stochastic discount factor is .535, a value that, combined with a wage volatility of .021 and a price of risk of .80, implies a risk-premium for a claim to aggregate wages of about .8%. This result is consistent with the common assumption about human capital being a low-risk asset, and similar to what others have estimated (for example, see Lustig, Van Nieuwerburgh, and Verdelhan (2013), and Palacios (2014)). The implied priced portion of productivity shocks, .384, suggests that the largest component of the productivity shocks received by firms is purely idiosyncratic.

Finally, the calibration implies a risk-free rate of 1% and a Sharpe ratio of .8. These values, particularly the risk-free rate, fall within the range of their widely-used estimates. Note that the only asset pricing moments we used were the average returns of the low- and high-labor-share portfolios. So we consider it a success that the calibration aligns with empirical observations for the risk-free rate and the market price of risk.

\[<< \text{Table X here} >>\]

Beyond point estimates for certain parameters, the calibration can be used to investigate the model’s capacity to replicate other relevant data. Table XI contrasts a large number of moments derived from the calibration with those found in the data. Those explicitly targeted in the calibration are presented in bold, while the remaining ones are not targeted.

Table XI, Panel A, contrasts moments for macroeconomic variables in the data and in the model. We highlight the result for the comovement—captured as a slope coefficient—of wage and GDP growth. The model delivers a coefficient of .150, which implies that wages are relatively smooth in the model, just as they are in the data (coefficient of .141). This is relevant because wage smoothness is one of the conditions we identify in Section I as being conducive to labor leverage.

Panels B and C contain moments related to the cross-section of firm cash flows. Since we target the cross-sectional standard deviation of firm-level value-added growth, it is not surprising that the resulting moment in the model is close to that one in the data. We do not explicitly target
the average and the standard deviation of labor share, which is a moment our model must match in order to be credible. Fortunately, Panel C shows that our model does match this. Panel D contrasts the sensitivities relevant to the labor leverage mechanism generated by the model with those from the data.

Finally, Panel E links asset prices related to labor leverage found in the data with those found in the model. The model and the data imply asset returns of 2.83% and 2.88% for the low labor share portfolio and asset returns of 6.24% and 5.88% for the high labor share portfolio, respectively. Panel E closes our exercise by closely replicating the returns of portfolios sorted by labor share.

Taken as a whole, the results summarized in Table XI imply that our simple, partial equilibrium model for firm dynamics, relating labor share and asset returns via a labor leverage mechanism, succeeds in explaining the patterns for returns observed in the data.

<< Table XI here >>
Conclusion

This paper proposes that labor share is a promising new firm characteristic that explains the cross-section of returns. We develop a simple production-based model of a firm to study the labor leverage mechanism. This model provides theoretical motivation for the use of labor share as a firm-level measure of the degree of labor leverage. The model shows that two sufficient conditions for the use of labor share as a proxy for labor leverage are: (a) Labor and capital are strict complements, and (b) economy-wide wages are smoother than aggregate productivity. These two sufficient conditions are generally supported in the data. Moreover, this paper provides model-agnostic empirical evidence that validates labor share as a measure of labor leverage. In particular, we document that the sensitivity of operating profits to shocks is cross-sectionally increasing in labor share. We further confirm a positive relation between labor leverage and expected asset returns. For instance, we show that average realized stock returns and average loadings on traditional systematic risk factors are increasing in labor share.

There are many important avenues for future work. International evidence that relates the strength of labor leverage to the properties of productivity and wages in each country could be assembled. Time variation in the importance of labor leverage in the United States could also be studied. A more general model that encompasses key labor market frictions could be developed to add to our frictionless model. Finally, the implications for asset prices when workers are partially insured are also an important potential extension.
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Appendix A

Census Data Details

Data

We use confidential establishment-level data from the Annual Survey of Manufactures (ASM) collected by the U.S. Census Bureau and supplant them with the KLEMS Multifactor Productivity Tables by Industry for Manufacturing Industries provided by the Bureau of Labor Statistics (BLS).

The U.S. Census Bureau collects annual data on manufacturing establishments in the ASM since 1972. The 50 to 60 thousand establishments comprise large establishments sampled with certainty every year (about half of the overall sample) and small establishments sampled with a lower probability but for five consecutive years. The sampling design of the ASM is aimed at a dataset that accurately reflects manufacturing employment and output while maintaining a representative age distribution: exiting establishments are replaced with a set of new and incumbent establishments so that the age distribution reflects that in the business register. We follow conventional practice and drop all observations which are imputed from administrative records (AR=1) or which are not part of the tabbed sample (i.e., observations with such a low quality and relevance that Census ignores them when publishing official tabulations). These establishments are also small enough to be considered unimportant for economic aggregates.

Following common practice among researchers working with the ASM, we correct industry codes as proposed in Davis, Haltiwanger, and Schuh (1998), transform the 1972-based SIC codes into 1987-based codes and all pre-1997 SIC codes into 6-digit NAICS codes to obtain a consistent industry classification for each establishment. This will be necessary to merge industry-level data by the BLS (see below).

The labor share is generally defined as the ratio of labor expenses and value added, and we will now describe how we measure both of these.

Measuring labor costs

We define the following items as labor costs: salaries and wages (item $SW$), involuntary labor costs (item $ILC$) such as unemployment insurance or social security contributions netted out from wages and voluntary labor costs (item $VLC$) such as health, retirement and other benefits paid to employees. Labor input comprises both full-time employees and temporary workers, a distinction
visible in Census data since 2002. Before that year, the instructions to establishments how to report the workforce and labor cost is ambiguous, but studying the development of employment and labor expenses before and after 2002 suggests most establishments included all worker compensation – both permanent and temporary – in their reported statistics.

Our labor expenses measure lacks any non-monetary compensation or ownership rights which have monetary value to an employee. Stock options, for example, are counted as labor income for tax purposes once a manager exercises the option but not at the point in time when the manager acquires the option. This downward bias of our labor share measure is likely uncorrelated with two-years ahead stock returns and thus won’t impact our results below.

**Measuring value added**

Value added in the Census data is measured as sales less inventory investment for final and work-in-progress goods, resales,\(^{36}\) material inputs and energy expenditures. Unlike in industry-level BLS data, purchased services, another intermediate input, are not reported in the Census data. To account for that, we reduce the value of an establishment’s production by the industry-year-specific share of purchased services computed from the 3-digit NAICS industry-level BLS data. Following common practice, we drop observations with a value added outside the 1%-iles of the overall pooled data; this also drop observations with negative value added. When aggregating our labor share measure, it is very close in level and dynamic properties to the aggregate labor share calculated from aggregate data in the BLS and BEA.

**Constructing firm labor shares**

Merging the ASM data to the Compustat panel requires aggregating establishments to the firm level. Our definition of a firm is based on the employer identification number (\(\text{EIN}\)) which we obtain from the Standard Statistical Establishment List (SSEL). In a given year, we sum labor expenses and value added of all establishments with the same \(\text{EIN}\) and take the ratio of these two variables to obtain the firm labor share:

\[
CLS = \frac{\text{labor expenses}}{\text{value added}}. \tag{A1}
\]

Since the ASM is not a comprehensive panel of all establishments, we do not observe all labor

\(^{36}\)This means we consider the value added by an establishment’s production activities, not its trading activities.
costs and the full value added of a firm. Only if establishments not sampled in the ASM have (1) a considerably different labor share than the establishments in the ASM and (2) are large enough to change the firm-level labor share, would our labor share measure be distorted. Fundamentally, the second point is already mute because, by construction, all large, economically significant establishments are covered in the ASM. So even significantly different labor shares of the not sampled establishments would not make a difference. Lastly, mismeasured labor shares at the firm level would not impact our analysis unless this measurement error was correlated with objects in our analysis such as stock market returns or operating profits. Like in the Compustat panel, we truncate all observations with a labor share outside the unit interval. This means dropping observations with negative value added or with negative gross profits where value added does not suffice to pay for labor expenses let alone capital costs. Like other researchers we smooth any hiccups in the transition to 1997 NAICS industry classification by replacing the 1997 value for the labor share with the average of the 1997 and 1996 values. Abiding with Census disclosure rules compels us to limit attention to observations with non-missing values in any variable needed for analysis in any of the statistical tables and regressions. This means we are left with a panel of about 572,700 year-firm observations from 1972-2009 where we observe the levels and growth rates of the labor share, non-labor operating costs, total operating costs and profits. That sample underlies the analysis using CLS as the labor share measure in Tables III (Panel B), IV and V (Panel B, right half).

Matching Census and Compustat data

The key analysis is to relate the Census labor share to the Compustat stock market returns. Of the 100k year-firm observations in the Compustat panel, we can match about 14k observations to firms in our panel of Census firms using the EIN. Using that variable gives us a higher match rate than using the Compustat bridge which extends only until 2005. The unmatched observations consist of years outside the ASM sample (before 1973/after 2009), non-manufacturing firms, firms with foreign ownership but no physical manufacturing operation in the U.S. and missing information on the matching variables. We further consider the data quality in matches where the capital stock imputed in the Census data differs from Property, Plant and Equipment in Compustat by more than a factor of three as ambiguous and drop them. This matched panel underlies Tables V (Panel B, left half), VI, VII and VIII. Regressing the growth rate of operating income before

\[37\] Part of Census disclosure requirements mean that only rounded number of observations are disclosed.
depreciation growth on labor shares creates missing values, so that the sample underlying Table VI (using CLS in Panel A) only comprises 10,400 observations. By Census disclosure requirement this was also the sample underlying the summary statistics in Panel C of Table I and Panel B (left half) of Table V.

In the matched Compustat-Census sample, we have several measures for the labor share. LS is directly measured in the Compustat data but only available for few observations, CLS is directly measured in the Census data and available for nearly all observations. ELS, in contrast, was imputed for those observations in the Compustat sample where we could not compute LS. It is natural to ask, (a) how well the two direct measures of the labor share line up and (b) how valid the imputation procedure is to obtain ELS. This is especially important to know for researchers that want to work with the labor share in Compustat but do not have access to the Census data.

Table A–1: Correlation between labor share measures

<table>
<thead>
<tr>
<th></th>
<th>CLS</th>
<th>No. obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS</td>
<td>0.561</td>
<td>1,700</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td></td>
</tr>
<tr>
<td>ELS</td>
<td>0.552</td>
<td>14,100</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td></td>
</tr>
</tbody>
</table>

Table A–1 displays the pooled correlation coefficients between the labor share measures. In order to convey a sense of economic importance, we weigh observations with their value added in a given year. The results show that both the directly measured LS and the imputed ELS are positively and significantly related to the labor share measured in the Census data. Given that the high quality of employment and labor compensation in the Census data, we hence conclude that analyzing labor shares in Compustat data using our imputation methods is a good approximation of the true labor share.

Derivation of Labor Leverage

Without fixed operating costs, the relative response of operating profit growth and value added
growth to shocks is given by

\[
\frac{d\Delta \pi_t}{d\Delta x_t} = \frac{1 + \frac{S_t}{1-S_t} \left( 1 - \frac{\partial \Delta w_t}{\partial \Delta x_t} \right)}{1 + \gamma \frac{S_t}{1-S_t} \left( 1 - \frac{\partial \Delta w_t}{\partial \Delta x_t} \right)}, \tag{A2}
\]

where \( \gamma_t \equiv \frac{F_{KL}[K_t,L_t]}{F[K_t,L_t]} \) is the elasticity of substitution between labor and capital, and \( S \equiv LW/Y \) is labor share. The expression follows from the following equalities:

\[
\frac{d\Delta l_t}{d\Delta x_t} = \gamma_t \frac{1 - S_t}{1 - S_t} \left( 1 - \frac{\partial \Delta w_t}{\partial \Delta x_t} \right), \tag{A3a}
\]
\[
\frac{d\Delta y_t}{d\Delta x_t} = 1 + \gamma_t \frac{S_t}{1 - S_t} \left( 1 - \frac{\partial \Delta w_t}{\partial \Delta x_t} \right), \tag{A3b}
\]
\[
\frac{d\Delta \pi_t}{d\Delta x_t} = \frac{1}{1 - S_t} \left( 1 - S_t \frac{\partial \Delta w_t}{\partial \Delta x_t} \right). \tag{A3c}
\]

**Operating Leverage, Labor Leverage, and Traditional Operating Leverage**

Now, assume that fixed operating costs are given by \( fK \), so that optimized operating profits are now given by

\[
\Pi^f_t = \max_{L_t} \{X_t F[K_t,L_t] - L_tW_t - fK \}, \tag{A4}
\]

where the superscript \( f \) in \( \Pi^f \) denotes operating profits when under fixed operating costs. Note that we can define the share of fixed costs to cash-flows net of labor costs, \( S^f \equiv \frac{fK}{Y(1-S)} \), so that

\[
\Pi^f_t = Y_t(1-S_t)(1-S^f_t) \tag{A5a}
\]
\[
= \Pi_t(1-S^f_t), \tag{A5b}
\]

where \( \Pi \) are operating profits in the otherwise identical case without fixed costs. Overall operating leverage includes components from labor leverage and from traditional operating leverage as given
by

\[
1 + \text{Operating Leverage} = \frac{d\Delta \Pi_t/d\Delta x_t}{d\Delta y_t/d\Delta x_t},
\]

(A6a)

\[
= \frac{d\Delta \Pi_t/d\Delta x_t}{d\Delta y_t/d\Delta x_t} \left( 1 + \frac{1}{1-S_t} \right),
\]

(A6b)

\[
= \frac{1 + \frac{S_t}{1-S_t} \left( 1 - \frac{\partial \Delta w_t}{\partial \Delta x_t} \right)}{1 + \gamma \frac{S_t}{1-S_t} \left( 1 - \frac{\partial \Delta w_t}{\partial \Delta x_t} \right)} \left( 1 + \frac{1}{1 - \frac{fK}{\Pi_t}} \right).
\]

(A6c)

Expression (A6c) shows how labor leverage and traditional leverage interact and magnify each other.

**Proof of proposition 1**

**Solution to the value of the firm**

We start with the standard PDE for the value of the firm implied by the condition that the discounted value of the gains portfolio that reinvests the firm’s dividends is a martingale. The solution to the value of a firm can be expressed as a function of its TFP \(X\) and its labor share \(S\), \(V[X_t, S_t]\). Given that operating profits (Equation (16)) are homogeneous of degree one in \(X\) and \(S\), we conjecture and later verify that the value of the firm is also homogeneous of degree one in \(X\) and \(S\). That is, we assume the existence of a function \(v[S]\) such that \(V[X, S] = XKv[S]\). The homogeneity of the value of the firm allows us to simplify the PDE into the following ordinary differential equation (ODE):

\[
h[S_t] - c_0 v[S_t] + c_1 S v'[S_t] + c_2 S^2 v''[S_t] = 0,
\]

(A7)
where:

\[ h[S_t] \equiv \frac{\Pi_t}{X_t K} = \begin{cases} 
(1 - \alpha)^{\frac{1}{\beta}} (1 - S_t)^{1 - \frac{1}{\beta}}, & \text{if } S_t < 1, \\
0, & \text{if } S_t \geq 1,
\end{cases} \]

\[ c_0 \equiv r - \lambda + \eta \rho X \sigma X - \mu X, \]
\[ c_1 \equiv \frac{\rho \left( 2 \eta \rho (\rho X \sigma X - \rho W \sigma W) + 2 \eta \rho W \sigma W - 2 \eta \rho X \sigma X - 2 \mu W (1 - \rho) + 2 \mu X (1 - \rho) - 2 \rho W \rho X \sigma W \sigma X + \sigma W^2 + \sigma X^2 \right)}{2(1 - \rho)^2}, \]
\[ c_2 \equiv \frac{\rho^2 (\sigma W^2 + \sigma X^2 - 2 \rho W \rho X \sigma W \sigma X)}{2(1 - \rho)^2}. \]

The value of the firm as \( S \to 0 \) converges to the value of a firm with a dividend of \( X_t K (1 - \alpha)^{\frac{1}{\beta}} \), a growth rate of \( \mu X \), and a discount rate of \( r + \eta \rho X \sigma X \), which results in \( \lim_{S \to 0} v[S] = \frac{(1 - \alpha)^{\frac{1}{\beta}}}{c_0} \). There are three other boundary conditions. The first one corresponds to \( \lim_{S \to \infty} v[S] = 0 \), since the value of a firm that further deviates from the region where it produces positive operating profits (i.e., its active region) should approach 0. The other two conditions are the smooth-pasting conditions when \( S = 1 \) (active–inactive threshold). At this point \( \lim_{S \to 1^-} v[S] = \lim_{S \to 1^+} v[S] \) and \( \lim_{S \to 1^-} v'[S] = \lim_{S \to 1^+} v'[S] \).

The solution to Equation (A7) in each of the two regions, active \( S < 1 \) and inactive \( S \geq 1 \), has the general form:

\[ v[S] = v_h[S] + v_p[S], \quad (A9) \]

where \( v_h[S] \) and \( v_p[S] \) are the homogeneous and particular solutions to ODE (A7).

We start by finding two linearly independent solutions to the corresponding homogeneous differential equation:

\[ v_h[S] = C_1 S^{\sigma_1} + C_2 S^{\sigma_2}, \quad (A10) \]
where $x_1$ and $x_2$ are given by:

$$x_1 = \frac{c_2 - c_1 + \sqrt{(c_2 - c_1)^2 + 4c_0 c_2}}{2c_2}, \quad (A11a)$$

$$x_2 = \frac{c_2 - c_1 - \sqrt{(c_2 - c_1)^2 + 4c_0 c_2}}{2c_2}. \quad (A11b)$$

Since, by assumption, $c_0 c_2 > 0$, it follows that $x_1 > 0 > x_2$. This observation will be used below.

We are looking for a particular solution of the following type:

$$v_p[S] = g_1[S]x^{x_1} + g_2[S]x^{x_2}. \quad (A12)$$

Without loss of generality, assume $g_1'[S]x^{x_1} + g_2'[S]x^{x_2} = 0$, then substitute the particular solution into the ODE. Thus, we obtain the following system of equations:

$$g_1'[S]x^{x_1} + g_2'[S]x^{x_2} = 0 \quad (A13a)$$

$$g_1'[S]x^{x_1-1} + g_2'[S]x^{x_2-1} = \frac{(1 - \alpha)^{\frac{1}{\bar{\rho}}} \left(1 - (1 - S)^{1 - \frac{1}{\bar{\rho}}} \right)}{c_2 S^2}. \quad (A13b)$$

Solving for $g_1'[S]$ and $g_2'[S]$ we find:

$$g_1'[S] = \frac{(1 - \alpha)^{\frac{1}{\bar{\rho}}} \left(1 - (1 - S)^{1 - \frac{1}{\bar{\rho}}} \right)}{c_2 (x_1 - x_2)} S^{-1 - x_1}, \quad (A14)$$

$$g_2'[S] = -\frac{(1 - \alpha)^{\frac{1}{\bar{\rho}}} \left(1 - (1 - S)^{1 - \frac{1}{\bar{\rho}}} \right)}{c_2 (x_1 - x_2)} S^{-1 - x_2}. \quad (A15)$$

Therefore, the solution to the particular equation therefore is:

$$v_p[S] = \frac{(1 - \alpha)^{\frac{1}{\bar{\rho}}}}{x_1 - x_2} \left( S^{x_1} \int_{k_1}^S (1 - (1 - \tau)^{\frac{\rho - 1}{\bar{\rho}}}) \tau^{1 - x_1} d\tau - S^{x_2} \int_{k_2}^S (1 - (1 - \tau)^{\frac{\rho - 1}{\bar{\rho}}}) \tau^{1 - x_2} d\tau \right), \quad (A16)$$

for arbitrary constants $k_1$ and $k_2$. What remains is a choice of $k_1$ and $k_2$ so that the solution is well defined and the boundary conditions are satisfied. An easy choice is to take $k_1 = 1$ and $k_2 = 0$, then
the particular solution is
\[
v_p[S] = \frac{(1 - \alpha)^{\frac{1}{\beta}}}{x_1 - x_2} \left(-S^{x_1} \int_S^1 \left(1 - (1 - \tau)^{\frac{\beta-1}{\beta}}\right) \tau^{1-x_1} d\tau - S^{x_2} \int_0^S \left(1 - (1 - \tau)^{\frac{\beta-1}{\beta}}\right) \tau^{1-x_2} d\tau\right).
\] (A17)

The general solution will be the sum of the homogeneous solution and the particular solution. Since the value of the homogeneous solution can not grow without bound as \(S \to 0\) or as \(S \to \infty\) the constants in the homogeneous solution associated with \(S^{x_2}\) in the active region \(S < 1\) and \(S^{x_1}\) in the inactive region \(S \geq 1\) must be zero. Thus, the solution in the active region \(S < 1\) is:
\[
v[S] = D_1 S^{x_1} - \frac{2(1 - \alpha)^{\frac{1}{\beta}}}{\sigma^2(x_1 - x_2)} \left(S^{x_1} \int_S^1 \left(1 - (1 - \tau)^{\frac{\beta-1}{\beta}}\right) \tau^{-1-x_1} d\tau + S^{x_2} \int_0^S \left(1 - (1 - \tau)^{\frac{\beta-1}{\beta}}\right) \tau^{-1-x_2} d\tau\right),
\] (A18)
and the solution in the inactive region \(S \geq 1\) is
\[
v[S] = D_2 S^{x_2}.
\] (A19)

What remains is to find the constants \(D_1\) and \(D_2\) such that the smooth-pasting conditions hold. The limit of \(v_p[S]\) as \(S \to 0\) is 0, so meeting the boundary condition for \(S = 0\) will come from the solution to the homogeneous differential equation.

Define \(A_2 \equiv \int_0^1 \left(1 - (1 - \tau)^{\frac{\beta-1}{\beta}}\right) \tau^{-1-x_2} d\tau\). It is easy to see that
\[
v_p[1] = -\frac{2(1 - \alpha)^{\frac{1}{\beta}} A_2}{2c_2(x_1 - x_2)} \quad \text{and} \quad v'[1] = -\frac{2(1 - \alpha)^{\frac{1}{\beta}} x_2 A_2}{2c_2(x_1 - x_2)}.
\] Thus from the smooth-pasting conditions we obtain
\[
\frac{-2(1 - \alpha)^{\frac{1}{\beta}} A_2}{2c_2(x_1 - x_2)} + D_1 + \frac{(1 - \alpha)^{\frac{1}{\beta}}}{c_0} = D_2 \quad \text{(A20)}
\]
\[
\frac{-2(1 - \alpha)^{\frac{1}{\beta}} x_2 A_2}{2c_2(x_1 - x_2)} + D_1 x_1 = D_2 x_2. \quad \text{(A21)}
\]

46
Solving for $D_1$ and $D_2$, 

\[ D_1 = \frac{(1 - \alpha)^{\frac{1}{\sigma}}}{c_0} \frac{x_2}{x_1 - x_2}, \]  
\[ D_2 = \frac{(1 - \alpha)^{\frac{1}{\sigma}}}{2c_2(x_1 - x_2)} \left(-2A_2 + \frac{2c_2x_1}{c_0}\right). \]  

(A22) 

(A23) 

The complete solution to the value of the firm is, therefore 

In the active region $S < 1$: 

\[ v[S] = \frac{2(1 - \alpha)^{\frac{1}{\sigma}}}{2c_2c_0(x_1 - x_2)} \left((x_1 - x_2) \frac{2c_2}{2} + \frac{2c_2}{2}x_2S^{(1)} - c_oS^{(1)} \int_{x_1}^{x_2} (1 - (1 - \tau) \frac{p-1}{\rho}) \tau^{1-x_1} d\tau - c_oS^{(2)} \int_{0}^{S} (1 - (1 - \tau) \frac{p-1}{\rho}) \tau^{1-x_2} d\tau \right). \]  

(A24) 

In the inactive region $S \geq 1$: 

\[ v[S] = \frac{2(1 - \alpha)^{\frac{1}{\sigma}}}{2c_2c_0(x_1 - x_2)} \left(-A_2c_0 + \frac{2c_2x_1}{2}\right) S^{(2)}. \]  

(A25)
Table I
Summary Statistics

Panels A, B and C report time series averages of median (for A and B) or average (for C) characteristics of portfolios of firms sorted on labor share ($LS$), the extended measure of labor share ($ELS$), the Census measure of labor share ($CLS$), respectively. $LS$ is ratio of labor expenses over the sum of labor expenses, operating profits, and the change in inventories of final goods. The construction of $ELS$ is identical to that of $LS$, except that, for firms that do not report labor expenses, we proxy them by the product of the number of employees in the firm and the average wage in the industry. The Census measure of the labor share, $CLS$, is the ratio of labor costs over value added described in detail in the appendix. $Log. \ L/K$ is the logarithm of the ratio of the number of employees over PPE. $B/M$ is the shareholders’ book value of equity divided by the market value of equity. $Log. \ Size$ is the logarithm of market value of equity. $Log. \ Asset$ is the logarithm of the book value of assets. $Tang.$ is tangibility, and is defined as the ratio of plant, property, and equipment (PPE) over assets. $Org. \ Cap$ is organizational capital, constructed as in Eisfeldt and Papanikolaou (2013). $Lev.$ is leverage, and is defined as the ratio of the book value of debt minus cash and marketable securities over the book value of assets minus cash and marketable securities. $Prof.$ is the measure of gross profitability as defined by Novy-Marx (2013). All variables are adjusted for inflation as measured by the Consumer Price Index. The Compustat–based sample covers all industries in Compustat, except Financials, over the period 1963–2012. The matched Compustat–Census sample covers firms in manufacturing industries over the period 1973–2009.

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<td>0.62</td>
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<td>7.47</td>
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Panel A: $LS$-Quintile Portfolios (Compustat Sample)

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### Table I
Summary Statistics (Cont’d)

Panel C: CLS-Quintile Portfolios (Matched Compustat–Census Sample)

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<td>0.81</td>
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Table II
Smoothness and Cyclicality of Aggregate Wages and Aggregate Profits

This table reports measures of association of aggregate profit growth, aggregate GDP, TFP, and wage growth. The top panel reports the correlation of these variables. The bottom panel reports the volatility of each variable, the volatility normalized by that of GDP growth, and the slope coefficient of a regression on GDP growth. \( \text{gdp}^g \) is annualized growth calculated as the change of the logarithm of real GDP. \( \text{tfp}^g \) is annualized growth calculated as the change of the logarithm of TFP. \( \text{wage}^g \) is annualized growth calculated as the change of the logarithm of real wages. \( \text{profit}^g \) is annualized growth in corporate profits from the National Income and Product Accounts. The sample covers the period 1963–2012.

<table>
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<tr>
<th>Variable</th>
<th>( \text{gdp}^g )</th>
<th>( \text{tfp}^g )</th>
<th>( \text{wage}^g )</th>
<th>( \text{profit}^g )</th>
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<td>( \text{gdp}^g )</td>
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<td></td>
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<tr>
<td>( \text{tfp}^g )</td>
<td>0.862</td>
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<tr>
<td>( \text{profit}^g )</td>
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<tr>
<td>( \sigma )</td>
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<td>0.017</td>
<td>0.015</td>
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<tr>
<td>( \sigma / \sigma_{\text{gdp}} )</td>
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<td>0.573</td>
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<tr>
<td>Slope on ( \text{gdp}^g )*</td>
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* Slope \( \beta_1 \) from regression \( x_t = \beta_0 + \beta_1 \text{gdp}^t \).
Table III

Smoothness of Labor Costs

This table reports estimates of panel data regressions of changes of costs on changes in sales. $Δlc$ and $lc^{\%}$ are the $\$ and $%$ changes of staff expenses. $Δnlc$ and $nlc^{\%}$ are the $\$ and $%$ changes of the sum of operating expenses (SG&A and COGS) minus staff expenses in Panel A (Compustat data); they are the summed expenses for intermediate and energy inputs in Panel B (Census data). $Δtc$ and $tc^{\%}$ are the $\$ and $%$ changes of the sum of operating expenses (SG&A and COGS) in Panel A; they are the expenses for labor compensation, intermediate and energy inputs in Panel B. Standard errors clustered by year are shown in parentheses. Significance levels are denoted by ($\ast = 10%$ level), ($\ast\ast = 5%$ level), and ($\ast\ast\ast = 1%$ level). The Compustat–based sample covers all industries in Compustat, except Financials, over the period 1963–2012. The Census sample covers manufacturing industries over the period 1973-2009.

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<tr>
<th>Cost (Dependent Variable)</th>
<th>$Δlc$</th>
<th>$Δnlc$</th>
<th>$Δtc$</th>
<th>$lc^{%}$</th>
<th>$nlc^{%}$</th>
<th>$tc^{%}$</th>
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<tr>
<td>Panel A: Compustat Sample</td>
<td>$Δsale$</td>
<td>$0.09^{***}$</td>
<td>$0.72^{***}$</td>
<td>$0.81^{***}$</td>
<td>$0.43^{***}$</td>
<td>$1.46^{***}$</td>
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<td>sale$^{%}$</td>
<td>$(0.01)$</td>
<td>$(0.03)$</td>
<td>$(0.03)$</td>
<td>$(0.16)$</td>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>8,173</td>
<td>8,173</td>
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<td>$0.69^{***}$</td>
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<td>sale$^{%}$</td>
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### Table IV

**Cyclicality of Labor Share**

This table reports estimates and standard errors of panel data regressions of log. growth of measures of labor share (*LS*, *ELS*, and *CLS*) on growth in business cycle indicators. $gdp^g$ is the change of the logarithm of real GDP. $tfp^g$ is the change of the logarithm of TFP. $mkt^g$ is the lagged annualized excess return of the market factor described in Fama and French (1993) and obtained from Kenneth French’s website. Standard errors clustered by year are shown in parentheses. Significance levels are denoted by (* = 10% level), (** = 5% level), and (***) = 1% level). The sample underlying *LS* and *ELS* covers firms in all industries in Compustat, except Financials, over the period 1963–2012. The sample underlying *CLS* covers firms in manufacturing industries in the Census dataset over the period 1973-2009.

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<td>-0.52***</td>
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<tr>
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Table V  
Labor Share and Sensitivity of Operating Profits to Aggregate Shocks

This table reports estimates and standard errors of panel data regressions of measures of real operating income before depreciation growth (OP\(_g\)) on an aggregate shock (GDP, TFP, or wage growth), lagged labor share, and interaction between lagged labor share and the aggregate shock. \(gdp^g\), \(tfp^g\), and \(mkt^g\) are defined in Table IV. \(LS\), \(ELS\), and \(CLS\) are standardized so that the cross-sectional standard deviation is one in every year. Standard errors clustered by year are shown in parentheses. Significance levels are denoted by (\(* = 10\%\) level), (\(* * = 5\%\) level), and (\(* * * = 1\%\) level). The sample underlying \(LS\) and \(ELS\) covers firms in all industries in Compustat, except Financials, over the period 1963–2012. The Compustat–Census matched sample covers firms in manufacturing industries over the period 1973-2009. The Census sample covers firms in manufacturing industries over the period 1973-2009.

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<td>(tfp^g)</td>
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<td>(ELS)</td>
<td>(CLS)</td>
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<td>Compustat–Census</td>
<td>Census</td>
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<tr>
<td></td>
<td>(0.21)</td>
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<td>(0.04)</td>
</tr>
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53
### Table VI

**Average Stock Returns of Firms Sorted on Labor Share**

This table reports annual excess stock returns of equal- and value-weighted portfolios of firms sorted on lagged $LS$, $ELS$, and twice-lagged $CLS$. H-L is the zero net investment portfolio long high labor share (H) stocks and short low labor share (L) stocks. Quintile thresholds in equal-weighted sorts are based on a sample that excludes micro-cap stocks, which are defined as stocks with market values below the bottom NYSE 20% percentile. Quintile thresholds that define value-weighted portfolios are solely based on the sample of stocks listed on NYSE on a given year. Newey-West standard errors estimated with five lags are shown in parentheses. The sample underlying $LS$ and $ELS$ covers all industries in Compustat, except Financials, over the period 1964–2012. The sample underlying $CLS$ covers manufacturing industries in the matched Compustat–Census sample over the period 1973-2009.

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<th>H-L</th>
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<tr>
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<td>8.17***</td>
<td>9.10***</td>
<td>9.64***</td>
<td>13.73***</td>
<td>6.41***</td>
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<tr>
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<td>(1.72)</td>
<td>(2.08)</td>
<td>(2.02)</td>
<td>(2.84)</td>
<td>(2.26)</td>
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<td>10.74***</td>
<td>10.77***</td>
<td>12.72***</td>
<td>14.72***</td>
<td>5.23**</td>
</tr>
<tr>
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<td>(2.45)</td>
<td>(2.13)</td>
<td>(2.41)</td>
<td>(2.72)</td>
<td>(3.12)</td>
<td>(2.25)</td>
</tr>
<tr>
<td>$CLS$</td>
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<td>12.68***</td>
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<td>(2.55)</td>
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<td>7.93***</td>
<td>7.33***</td>
<td>5.60**</td>
<td>9.24***</td>
<td>3.48*</td>
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<td>(2.45)</td>
<td>(2.22)</td>
<td>(1.87)</td>
</tr>
<tr>
<td>$ELS$</td>
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<td>6.86***</td>
<td>6.73***</td>
<td>8.38***</td>
<td>10.23***</td>
<td>3.94**</td>
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<td>(1.84)</td>
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<td>(2.70)</td>
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This table shows estimates and standard errors of panel data regressions of annual stock returns on twice-lagged measures of labor share and controls for leverage and assets. \textit{LS}, \textit{ELS}, and \textit{CLS} are standardized so that their standard deviation is one. Standard errors clustered by firm are shown in parentheses. Significance levels are denoted by \((* = 10\% \text{ level}), (**) = 5\% \text{ level}), and (***) = 1\% \text{ level})\). The sample underlying \textit{LS} and \textit{ELS} covers all industries in Compustat, except Financials, over the period 1964–2012. The sample underlying \textit{CLS} covers manufacturing industries in the matched CRSP–Census sample over the period 1973-2009.

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<td>III</td>
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<td>II</td>
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Table VIII
Risk Factor Loadings

This table reports the average conditional betas of portfolios of stocks sorted on lagged measures of labor share \(LS\), \(ELS\), and \(CLS\). MKT, SMB, and HML are the market, size, and value risk factors described in Fama and French (1993) and obtained from Kenneth French’s website. \(tfp^g\), \(wage^g\), and \(gdp^g\) are total factor productivity, wages, and gross domestic product growth described in Table II. H-L is the zero net investment portfolio long high labor share (H) stocks and short low labor share (L) stocks. Newey-West standard errors estimated with one lag are shown in parentheses. Significance levels are denoted by \(* = 10\%\) level), \(** = 5\%\) level), and \(*** = 1\%\) level). The sample underlying \(LS\) and \(ELS\) covers all industries in Compustat, except Financials, over the period 1964–2012. The sample underlying \(CLS\) covers manufacturing industries in the matched CRSP–Census sample over the period 1973-2009.

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<th>4</th>
<th>H</th>
<th>H-L</th>
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<td>0.81(***)</td>
<td>1.08(***)</td>
<td>1.21(***)</td>
<td>1.37(***)</td>
<td>0.68(***)</td>
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<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.04)</td>
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<tr>
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<td>0.49(***)</td>
<td>0.87(***)</td>
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<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.05)</td>
<td></td>
</tr>
<tr>
<td>SMB</td>
<td>0.50***</td>
<td>0.67***</td>
<td>0.87***</td>
<td>0.81***</td>
<td>0.91 ***</td>
<td>0.41 ***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.08)</td>
<td>(0.05)</td>
<td>(0.07)</td>
<td>(0.07)</td>
<td>(0.10)</td>
<td></td>
</tr>
<tr>
<td>HML</td>
<td>-0.91***</td>
<td>-0.93***</td>
<td>-0.97***</td>
<td>-0.81***</td>
<td>-0.84 ***</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(0.25)</td>
<td>(0.27)</td>
<td>(0.25)</td>
<td>(0.24)</td>
<td>(0.12)</td>
<td></td>
</tr>
<tr>
<td>$t_{fp}$</td>
<td>5.39*</td>
<td>5.29**</td>
<td>5.85**</td>
<td>6.57**</td>
<td>5.82 **</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.78)</td>
<td>(2.48)</td>
<td>(2.63)</td>
<td>(2.69)</td>
<td>(2.70)</td>
<td>(1.65)</td>
<td></td>
</tr>
<tr>
<td>$g_{dp}$</td>
<td>3.05</td>
<td>4.05*</td>
<td>4.08</td>
<td>4.14*</td>
<td>4.29*</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.28)</td>
<td>(2.40)</td>
<td>(2.65)</td>
<td>(2.30)</td>
<td>(2.40)</td>
<td>(0.84)</td>
<td></td>
</tr>
<tr>
<td>$wage$</td>
<td>-1.01</td>
<td>2.56</td>
<td>3.09</td>
<td>2.25</td>
<td>3.28</td>
<td>4.29</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.36)</td>
<td>(3.26)</td>
<td>(3.77)</td>
<td>(2.99)</td>
<td>(3.51)</td>
<td>(3.42)</td>
<td></td>
</tr>
</tbody>
</table>
Table IX
Target Moments in Calibration

This table shows the target moments and the loss function weights used in the calibration of the model.

<table>
<thead>
<tr>
<th>Moment</th>
<th>Target Moment</th>
<th>LF Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moments from Macroeconomic Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volatility of GDP growth</td>
<td>0.035</td>
<td>0.095</td>
</tr>
<tr>
<td>Volatility of aggregate TFP growth</td>
<td>0.020</td>
<td>0.095</td>
</tr>
<tr>
<td>Volatility of aggregate wage growth</td>
<td>0.018</td>
<td>0.095</td>
</tr>
<tr>
<td>Correlation between GDP growth and agg. TFP growth</td>
<td>0.862</td>
<td>0.048</td>
</tr>
<tr>
<td>Correlation between GDP growth and agg. wage growth</td>
<td>0.275</td>
<td>0.048</td>
</tr>
<tr>
<td>Correlation between agg. TFP growth and agg. wage growth</td>
<td>0.482</td>
<td>0.048</td>
</tr>
<tr>
<td><strong>Moments from Firm-Level Cash Flows</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Labor Share</td>
<td>0.594</td>
<td>0.583</td>
</tr>
<tr>
<td>Cross-Sectional Std. Dev. of Value-Added Growth</td>
<td>0.131</td>
<td>0.048</td>
</tr>
<tr>
<td>Cross-Sectional Std. Dev. of Labor Share</td>
<td>0.186</td>
<td>0.048</td>
</tr>
<tr>
<td>Slope of GDP growth from regression (8)</td>
<td>1.960</td>
<td>0.024</td>
</tr>
<tr>
<td>Slope of TFP growth from regression (8)</td>
<td>2.830</td>
<td>0.024</td>
</tr>
<tr>
<td>Slope of interaction (LS \times ) GDP growth from regression (8)</td>
<td>1.150</td>
<td>0.024</td>
</tr>
<tr>
<td>Slope of interaction (LS \times ) TFP growth from regression (8)</td>
<td>1.530</td>
<td>0.024</td>
</tr>
<tr>
<td><strong>Moments from Firm-Level Unlevered Stock Returns</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return of Low-Labor-Share Quintile Portfolio</td>
<td>2.830</td>
<td>0.095</td>
</tr>
<tr>
<td>Return of High-Labor-Share Quintile Portfolio</td>
<td>4.720</td>
<td>0.095</td>
</tr>
<tr>
<td>Return of High-minus Low-Labor-Share Quintile Portfolio</td>
<td>1.890</td>
<td>0.095</td>
</tr>
</tbody>
</table>
Table X
Parameter Calibration

This table shows the parameter values obtained in the model calibration.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Productive Technology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K-L elasticity of substitution</td>
<td>$\frac{1}{1-\rho}$</td>
<td>0.400</td>
</tr>
<tr>
<td>Weight of labor in productive technology</td>
<td>$\alpha$</td>
<td>0.814</td>
</tr>
<tr>
<td><strong>Shocks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volatility of wage shocks</td>
<td>$\sigma_w$</td>
<td>0.017</td>
</tr>
<tr>
<td>Drift of wage shocks</td>
<td>$\mu_w$</td>
<td>0.029</td>
</tr>
<tr>
<td>Priced portion of wage shocks</td>
<td>$\rho_w$</td>
<td>0.519</td>
</tr>
<tr>
<td>Volatility of productivity shocks</td>
<td>$\sigma_A$</td>
<td>0.076</td>
</tr>
<tr>
<td>Drift of productivity shocks</td>
<td>$\mu_A$</td>
<td>0.034</td>
</tr>
<tr>
<td>Priced portion of productivity shocks</td>
<td>$\rho_A$</td>
<td>0.377</td>
</tr>
<tr>
<td>Initial productivity level over wage level</td>
<td>$A_0/W_0$</td>
<td>2.078</td>
</tr>
<tr>
<td>Annual firm death rate</td>
<td>$\lambda$</td>
<td>0.010</td>
</tr>
<tr>
<td><strong>Stochastic Discount Factor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk-free rate</td>
<td>$r$</td>
<td>0.010</td>
</tr>
<tr>
<td>Price of risk</td>
<td>$\eta$</td>
<td>0.839</td>
</tr>
</tbody>
</table>
**Table XI**  
**Moments from the Data and from the Model**

This table compares moments from our calibrated model with those from the data. Simulated data from the model are generated from 10,000 panels of 10,000 firms over 1,200 months (only the last year is used in the analyses). Targeted moments from the data are in bold.

<table>
<thead>
<tr>
<th>Panel A: Smoothness and Cyclicality of Macroeconomic Variables</th>
<th>Data*</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>gdp$^g$</td>
<td>tfp$^g$</td>
</tr>
<tr>
<td>gdp$^g$</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>tfp$^g$</td>
<td>0.862</td>
<td>1.000</td>
</tr>
<tr>
<td>wage$^g$</td>
<td>0.275</td>
<td>0.480</td>
</tr>
<tr>
<td>profit$^g$</td>
<td>0.628</td>
<td>0.621</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.030</td>
<td>0.017</td>
</tr>
<tr>
<td>Slope on gdp$^g$*</td>
<td>1.000</td>
<td>0.494</td>
</tr>
</tbody>
</table>

| Panel B: Cross-Sectional Standard Deviation of Firm-Level Value-Added Growth | 0.131 | 0.152 |

<table>
<thead>
<tr>
<th>Panel C: Mean and Cross-Sectional Standard Deviation of Labor Share</th>
<th>Mean</th>
<th>0.594</th>
<th>0.582</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma$</td>
<td>0.186</td>
<td>0.183</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel D: Sensitivity of Operating Profit Growth to GDP and TFP Shocks</th>
<th>gdp$^g$</th>
<th>tfp$^g$</th>
<th>gdp$^g$</th>
<th>tfp$^g$</th>
</tr>
</thead>
<tbody>
<tr>
<td>gdp$^g$</td>
<td>1.96</td>
<td>1.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_{it-1} \times$ gdp$^g$</td>
<td>1.15</td>
<td>0.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tfp$^g$</td>
<td>2.83</td>
<td>2.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_{it-1} \times$ tfp$^g$</td>
<td>1.53</td>
<td>0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$S_{it-1}$</td>
<td>0.13</td>
<td>0.14</td>
<td>-0.01</td>
<td>-0.01</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel E: Portfolio Sorts (Unlevered Stock Returns / Asset Returns)</th>
<th>L</th>
<th>2.88</th>
<th>2.83</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3.53</td>
<td>3.52</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4.69</td>
<td>4.06</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4.56</td>
<td>4.74</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>5.88</td>
<td>6.24</td>
<td></td>
</tr>
<tr>
<td>H-L</td>
<td>2.99</td>
<td>3.41</td>
<td></td>
</tr>
</tbody>
</table>

* Values in bold are target moments of the model calibration.