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# DECLINING LABOR SHARES AND THE GLOBAL RISE OF CORPORATE SAVINGS

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**ABSTRACT**

We document a 5 percentage point decline in the share of global corporate income paid to labor from the mid-1970s to the late 2000s. Increased dividend payments did not absorb all of the resulting increase in profits, and therefore, the supply of corporate savings increased by over 20 percentage points as a share of total global savings. These trends were stronger in countries experiencing greater declines in the relative price of investment goods. We develop a model featuring CES production and imperfections in the flow of funds between households and corporations. These two departures from the standard neoclassical model imply that the labor share fluctuates and the sectoral composition of savings affects macroeconomic allocations. We calibrate the shape of the production function and the capital market imperfections to match the cross-sectional variation in the two trends. In response to the observed global decline in investment prices, our model generates more than half of the observed changes in labor shares and corporate savings. The non-unitary elasticity of substitution between capital and labor interacts with imperfections in the capital market to jointly shape the economy's dynamics.

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# 1 Introduction

We document a 5 percentage point decline in the share of global corporate gross value added paid to labor over the last 30 years. Dividend payments to shareholders did not increase by more than the resulting increase in corporate profits and the size of the corporate sector did not change relative to total economic activity. Therefore, this decline in the labor share produced an increase in the share of total savings originating from the corporate sector, or the corporate savings share, of more than 20 percentage points. These estimates represent averages across various specifications that account for compositional changes in our unbalanced panel. Instead, in Figure 1, we plot the evolution of corporate labor shares and corporate savings shares for a global aggregate constructed by simply summing data from all available countries in our sample. Figure 2 shows that both trends are present in each of the largest four economies.

It is impossible to interpret these global trends through the lens of the standard neoclassical growth model because it features Cobb-Douglas production and perfect capital markets. As a result, factor shares are constant and corporate savings are not well-defined. By contrast, we develop a model in which production combines capital and labor with a constant elasticity of substitution (CES) different from one and in which imperfections in the capital market restrict the flow of funds between households and corporations. These two departures from the standard model imply that the labor share fluctuates in response to relative input prices and the sectoral composition of savings affects macroeconomic allocations. We use the model to relate these trends to the observed global decline in the relative price of investment goods and to show how changes in labor shares and corporate savings are jointly informative about the evolution of macroeconomic objects such as investment, consumption, and GDP.

We start by demonstrating the robustness of the decline in the labor share using a novel dataset we compile by combining country-specific data posted on the Internet with sector-level national income accounting data from multilateral organizations obtained digitally and collected from physical books. Of the 51 countries with more than 10 years of data between 1975 and 2007, 36 exhibited downward trends in their corporate labor share. Of the trend estimates that were statistically significant, 29 were negative while only 10 were positive. Our findings on the labor share are consistent with and expand upon earlier work such as Blanchard (1997), Jones (2003), and Bentolila and Saint-Paul (2003).

The global shift from labor income to profits was associated with an equally widespread shift from household to corporate savings. Of the 44 countries with more than 10 years of data, 30 exhibited increasing trends in the share of savings due to the corporate sector. 22 of these trends were statistically significantly greater than zero, while only 9 were significantly less than zero. These global findings are consistent with the country-specific results in Hsieh and Parker (2006) for Chile, Bayoumi, Tong, and Wei (2010) for China, and Armenter and Hnatkovska (2011) for the United States.

We develop a perfect-foresight general equilibrium model consisting of a continuum of corporations owned by an infinitely lived representative household that derives utility from consumption, leisure, and the stock of household capital. Following Auerbach (1979), Poterba and Summers (1985), and Gourio and Miao (2010, 2011), corporate investment and debt and equity financing decisions aim to maximize shareholder wealth via dividend payments and equity repurchases, both of which are subject to constraints. If a shock increases desired investment by firms at a time when corporate savings are low, firms may wish to cut back significantly on dividend payments but may not be able to do so due to a minimum-dividend constraint. If household demand is low that period, households, as equity holders, would wish to inject capital into firms. But capital market imperfections prevent them from doing so to the desired extent.

Imperfections in capital markets make corporate savings interesting for macroeconomic allocations because they imply that firms prefer to finance their investment internally with their savings. The implications of such capital market imperfections find strong support in our data. Figure 3 plots the average corporate investment rate against the average corporate savings rate for all countries in our dataset, a sectoral version of the well-known Feldstein and Horioka (1980) puzzle in open-economy macroeconomics.[1] Models with perfect capital markets make no meaningful predictions for the relationship between corporate investment rates and corporate savings rates. In our dataset, however, the two rates are strongly correlated with a slope coefficient of 0.54 that is statistically significant at the 1 percent level.

Our model links trends in factor and savings shares to investment prices and investment rates, which also exhibited noticeable trends in the data. The solid line in Figure 4 plots the global decline in the price of investment goods relative to the price of consumption goods. The short-dashed line plots the rise in global nominal corporate investment spending as a share of GDP and the long-dashed line plots year fixed effects from a regression of real corporate investment relative to GDP (using a deflator discussed in the figure's notes). The global decline in investment prices which accelerated in the early 1980s is consistent with the decline in U.S. investment prices documented by Greenwood, Hercowitz, and Krusell (1997) and Fisher (2006). The short-

[1]In all cross-country plots and regressions in this paper, we winsorize the single largest and smallest data points in each dimension, keeping them in the plots and regressions, but setting their levels to that of the second largest or smallest data points. Given the small number of observations in the cross section of countries, we do this to have a consistently applied rule that prevents large outliers from obscuring all other empirical variation.

dashed and the long-dashed lines account differentially for compositional changes in our sample. Collectively, however, they suggest that real corporate investment relative to GDP increased by 35 to 50 percent between 1975 and 2007.

Declines in corporate labor shares and increases in corporate savings shares were larger in countries that experienced larger declines in the relative price of investment. We use the cross-country relationship between trends in corporate labor shares and trends in the relative price of investment to calibrate the elasticity of substitution between capital and labor. This elasticity is important for determining desired corporate investment in response to movements in the user cost of capital. In parallel to our calibration of the production function, we use the cross-country relationship between trends in corporate savings shares and trends in the relative price of investment to calibrate parameters governing corporate financial policy which, in turn, determine the strength of imperfections in the capital market. The strength of these imperfections is important for determining the growth in the user cost of capital in response to shocks. After calibrating our model using these cross-sectional relationships, we shock it with the observed global decline in the relative price of investment. We find that the model generates a significant movement from an initial steady state with a high labor share and low corporate savings share to another steady state with a low labor share and high corporate savings share. In particular, the model accounts for more than half of the global trends shown in Figure 1.

It is important to study corporate labor and savings shares jointly in one framework given their relationship implied by accounting identities. The fact that they move in opposite directions in response to a single investment price shock both in the data and in our model corroborates our mechanism compared to others that generate movements in only one of the two trends or that cause labor shares and corporate savings to move in the same direction. Further, the joint determination of labor shares and corporate savings is interesting because of a quantitatively significant interaction between the elasticity of substitution in the production function and the existence of capital market imperfections. The importance of capital market imperfections increases with desired investment and, in response to shocks that either lower the cost of capital or increase the marginal product of capital, desired investment increases with the elasticity of substitution between capital and labor. As a result, the higher is the elasticity of substitution the more capital market imperfections impact the growth in corporate investment.

To highlight this interaction, we compare the response of our model to the investment price shock with the response of models that assume Cobb-Douglas production, perfect capital markets, or both. The models with perfect capital markets share the same structure as our baseline model but allow the planner to freely shift resources across sectors. The three alternative models ignore the information contained in, and cannot reproduce, at least one (if not both) of the trends in Figure 1. We show that, in response to the global investment price shock, steady state to steady state GDP growth in the Cobb-Douglas model differs by less than 1 percentage point between the model with capital market imperfections and the model with perfect capital markets. In the CES framework, however, GDP growth differs by roughly 4.5 percentage points between the two models. The information contained in the two trends is also important for the economy's response to other shocks. For instance, in response to TFP shocks, growth in a Cobb-Douglas economy does not depend on whether capital markets are perfect or imperfect. By contrast, TFP shocks in a CES economy imply different growth outcomes depending on the structure of capital markets.

Countries experiencing larger declines in relative investment prices experienced larger labor share declines, and this leads to our estimated elasticity of substitution between capital and labor of 1.4.[2] As discussed in Jones (2003), a balanced growth path with non-zero factor shares will only emerge if technology growth is labor-augmenting, regardless of the production function, or if the production function is Cobb-Douglas, even if technology growth is capital-augmenting. If real wage growth or increases in the capital-to-labor ratio are caused by labor-augmenting technology growth, there need not be movement in the labor share. If instead the large increases in wages or capital-to-labor ratios seen in high growth countries such as the Asian Tigers followed from Hicks-neutral technology growth, they would with our calibration imply a decline in the labor share. Our elasticity is close enough to one, however, where even such large growth episodes would not generate implausible predicted labor share movements.[3] Our estimated CES production function is also related to the work of Krusell, Ohanian, Rios-Rull, and Violante (2000), which features non-constant factor shares and studies how changes in the relative supply of skilled and unskilled labor can account for variation in the skill premium.

Our empirical work has close connections to important papers in empirical public and corporate finance. Poterba and Summers (1983, 1985), Poterba (1987), and Auerbach and Hassett (1991) examine the effect of taxation on corporate investment, savings, and financing decisions using data from the United States. Poterba (1989) examines the effects of corporate payouts on aggregate consumption using data from the United States, Canada, and the United Kingdom.[4]

[2] Antras (2004) notes that, while estimates vary, most empirical studies find the elasticity of substitution between capital and labor to be less than one. One reason our approach may yield a different result is that we are focused on a more long-term elasticity measured over at least 10 years rather than the higher frequency adjustments captured in most empirical studies.

[3] For example, Young (1995) measures a 7.1 percent annual growth rate in Taiwan's capital-to-labor ratio from 1966-1990. In a static model with constant returns to scale, Hicks-neutral growth, and our elasticity estimate, this implies a 10 percentage point decline in the labor share. This is a large decline, but does not stand out as exceptional relative to the rest of our data.

[4] We also build on an influential literature including papers such as Fazzari, Hubbard, and Petersen (1988),

Our model with capital market imperfections builds on Gomes (2001), Hennessy and Whited (2005), Riddick and Whited (2009), and Armenter and Hnatkovska (2011), who discuss issues of corporate financing in partial equilibrium environments.

Only recently have macroeconomists embedded the corporate sector in general equilibrium environments, which is required to emphasize the feedback between household and firm savings and investment decisions. Our model is related to those developed in Gourio and Miao (2010, 2011), which study the long-run effects and the transitional dynamics of the 2003 U.S. dividend and capital gains tax reform on macroeconomic outcomes. Jermann and Quadrini (2012) document the cyclical properties of financial flows in the United States and explore the effects of financial shocks along the business cycle in a calibrated model with a corporate sector.[5]

# 2 Data Description and Empirical Results

We now describe how our data are constructed and review the national income accounting framework which relates the corporate labor share to corporate profits, dividends, and savings. We then document the widespread decline in the corporate labor share and the rise in corporate savings relative to total savings and GDP over the past three decades.

## 2.1 National Income Accounting Data

We obtain annual data on income shares, savings, and other variables at the national and sector levels by combining six broad sources: (i) country-specific Internet web pages (such as that managed by the Bureau of Economic Analysis (BEA) for the United States); (ii) digital files obtained from the United Nations (UN); (iii) digital files obtained from the Organization for Economic Cooperation and Development (OECD); (iv) a separate database compiled in the mid-1990s by researchers at the World Bank (see Loayza, Schmidt-Hebbel, and Serven (2000)); (v) physical books published by the UN; and (vi) physical books published by the OECD.[6] Over time and across countries there are some differences in methodologies, but our data generally conform

Kaplan and Zingales (1997), and Rauh (2006) that discusses the sensitivity of corporate investment to cash flows in a variety of settings.

[5]See Turnovsky (1990) for some early work on the effects of tax policies on capital accumulation. See Bacchetta and Benhima (2010) on global imbalances and corporate demand for liquidity and Shourideh and Zetlin-Jones (2012) on the effects of financial shocks in economies in which firms have non-financial linkages.

[6]Unless otherwise specified, we refer to gross savings and investment rather than net savings and investment. We prefer the gross concepts since they offer better data availability and also relate most naturally to accounting identities for GDP. For example, the 1993 System of National Accounts states that "In general, the gross figure is obviously the easier to estimate and may, therefore, be more reliable..." Nonetheless, corporate net savings in our sample also rise significantly both as a share of total net savings and as a share of net domestic product.

to System of National Accounts (SNA) standards. We refer the reader to the SNA Section of the United Nations Statistics Division and to Lequiller and Blades (2006) for the most detailed descriptions of how national accounts are constructed and harmonized to meet these standards.

The resulting dataset contains sector-level information on the income structure of 59 countries for various years between 1975 and 2007, a significant increase in coverage relative to what is readily downloadable from the UN and OECD. We start our analysis in 1975 because that is the earliest year in which we have more than 6 countries with data on both the sectoral composition of savings and on the corporate labor share. We end the sample in 2007 to avoid problems from differential availability of data across countries after that point.

Appendix A, which can be found along with the other appendices on the authors' web pages, contains a detailed description of our baseline algorithm for obtaining a single dataset from these disparate sources. The Appendix also lists all countries in our dataset that have complete sectoral savings data as well as the years in which they enter and exit the dataset. To merge the data, we begin by using any statistics we are able to obtain from the Internet. This is our preferred source as it is the most likely to include any data revisions. We then rank all remaining sources by the number of available years of data for each country and use these sources (in order) when the preferred sources lack data. While there are some exceptions, this procedure typically implies that one or two sources contribute the bulk of the data for any given country. These key sources do, however, differ across countries. In Appendix B, we demonstrate the robustness of our core conclusions to several alternative methodologies for merging across datasets, such as rules on "smooth pasting" or restricting to only a single data source.

The key national accounting concepts used in the analyses below are represented in Figure 5. Broadly speaking, economic activity is divided in the SNA into the corporate ($C$), household ($H$), and government ($G$) sector. Our core findings are not sensitive to excluding the financial sector from the corporate sector. The household sector includes unincorporated businesses, sole proprietors, non-profits serving households, and the actual and imputed rental income accruing to non-corporate owners of housing. Nominal GDP $Y$ less taxes net of subsidies on products equals the sum of sectoral gross value added (final output less intermediate consumption):

$$Y - \text{Tax}_{\text{products}} = Q_C + Q_H + Q_G. \tag{1}$$

The aggregate labor share equals total compensation of labor across all three sectors divided by GDP, or $s_L = wn/Y$, where $w$ equals the average wage and $n$ equals hours worked. We instead focus on labor share in the corporate sector, $s_{L,C} = w_C n_C / Q_C$, because this object is closely related to corporate savings.[7] An added benefit is that labor share measured within the corporate sector is not impacted by the statistical imputation of wages from the combined capital and labor income earned by sole-proprietors and unincorporated enterprises, highlighted by Gollin (2002) as problematic for the consistent measurement of the labor share.

Corporate gross value added $Q_C$ equals the sum of compensation paid to labor $w_C n_C$, taxes net of subsidies on production, and a residual category capturing all payments to the capital factor, which in the data is called gross operating surplus:

$$Q_C = w_C n_C + \text{Tax}_{\text{production},C} + \text{Gross Operating Surplus}_C. \tag{2}$$

The sum of gross operating surplus and taxes on production is disaggregated into profits $\Pi_C$ and "other payments to capital" $OPK_C$. Other payments to capital is the only category on the right of Figure 5 that is not a category found directly in the national accounts. Rather, we use it to bundle together a number of sub-categories including, for example, taxes on production and interest payments on loans.[8] To maintain consistency with standard measurements of aggregate labor share, we allocate taxes on production entirely to $OPK_C$. We note that allocating a share of these taxes to labor compensation produces an even larger decline in the global labor share.

Profits $\Pi_C$ equal the corporate gross value added that remains after subtracting all payments to labor and capital:

$$\Pi_C = Q_C - w_C n_C - OPK_C = d_C + S_C. \tag{3}$$

Using this notation, we define the profit share as $s_{\Pi,C} = \Pi_C / Q_C$ and the share of other payments to capital in the corporate sector as $s_{K,C} = OPK_C / Q_C$. As can be seen in Figure 5, $s_{L,C} + s_{K,C} + s_{\Pi,C} = 1$. Profits that are not distributed as dividends $d_C$ constitute corporate savings $S_C$.

## 2.2 The Global Decline in Labor Shares

Figure 1 plots the evolution of the labor share of the corporate sector. This global aggregate was constructed using our unbalanced panel of countries as:

$$s_{L,C}(t) = \frac{\sum_{i \in \Omega(t)} w_C^i(t) n_C^i(t)}{\sum_{i \in \Omega(t)} Q_C^i(t)}, \tag{4}$$

[7] According to the SNA, compensation of employees includes wages and salaries in cash, wages and salaries in kind, and employers' social contributions for sickness, accidents, and retirement (to social security funds and insurance enterprises). Though the treatment of gains associated with the exercise of stock options is subject to data availability and is not uniform across countries, most developed countries try to account for the value of stock options granted to employees as part of labor compensation (Lequiller, 2002).

[8] The share of "other payments to capital" is significantly smaller than what "capital share" often means in macro models. This is because we separate other payments to capital from profits.

where $i$ denotes the country and $\Omega(t)$ is the set of countries in our data with observations on both $w_C n_C$ and $Q_C$ in year $t$. All variables are converted into U.S. dollars using the average market exchange rate for that year. If we instead calculate total labor share in our data, we get a nearly identical time series, but shifted downward by approximately 10 percentage points (owing in part to the inclusion of taxes in the denominator).[9]

The calculation in equation (4) simply adds up labor compensation and gross value added across countries, which clearly places more weight on larger countries like the United States and China. Most countries in the world, however, experienced this decline. Figure 6 shows the estimated coefficients on linear trends in corporate labor shares for all 51 countries with data available for at least 10 years. The coefficients are scaled such that the units represent the percentage point change in corporate labor share every 10 years. 36 countries exhibited labor share declines compared to 15 which experienced increases. Of those 39 countries where the trends were statistically significant at the 5 percent level, the corporate labor share declined in 29 of them. The largest 8 economies are highlighted in red, and with the United Kingdom as the only exception, they all exhibit statistically significant declines.

The corporate labor share of the global aggregate plotted in Figure 1 declines by 8.1 percentage points between 1975 and 2007. This estimate is larger what we use as our baseline in part because countries entering our dataset after 1975 have lower levels of corporate labor shares. To control for this change in composition in our unbalanced panel, we consider the evolution of time fixed effects estimated in regressions that also absorb country fixed effects. When we run this regression on the total set of countries with at least 10 years of available data, we obtain a decline in the corporate labor share of 6.0 percentage points from 1975 to 2007. When we limit the regression to the eight largest economies in 2000, the estimated decline equals 5.4 percent. If instead we weight these regressions by corporate gross value added, we obtain estimated declines of 4.3 and 4.7 percentage points, respectively. Averaging across these specifications, we obtain our baseline decline in global corporate labor share of 5 percentage points.

Our findings on labor shares are consistent with earlier work by Blanchard (1997), Jones (2003), and Bentolila and Saint-Paul (2003), which focuses on the variability of labor shares over the medium run, including the large declines seen during the 1980s in Western Europe. Harrison (2002) and Rodriguez and Jayadev (2010) use UN data and are the broadest studies of trends in labor shares. Harrison (2002) finds a decreasing trend in the labor share of poor countries but an increasing trend in rich countries for 1960-1997. Rodriguez and Jayadev (2010) estimate a

[9]There are a number of countries which lack the data required to calculate corporate labor share, but which have data on the overall labor share. In such cases, we use the aggregate figures but scale them up by the global ratio of corporate to overall labor share $s_{L,C}/s_L$ found in the dataset.

declining average trend in labor shares using an equally weighted set of 129 countries and report that within-country changes in industrial composition are not causing this decline.

Our results complement and expand upon this related literature. We capture significant movements in the labor share that start around 2000, include important non-OECD countries such as China, and use exchange rates to aggregate across countries and examine the global labor share. Further, by focusing on the labor share in the corporate sector, rather than the overall labor share, our results are less subject to measurement problems caused by the imputation of labor earnings in unincorporated enterprises and by shifts in economic activity across sectors. Finally, we offer evidence that variation in the labor share is strongly correlated with variation in components of the user cost of capital and corroborate the importance of this relationship by jointly studying the trend in corporate savings.

Such large and broad trends in the labor share may reflect contributions from multiple factors, but we now present evidence showing that labor share declines correlate with declines in the relative price of investment within and across countries as well as over time at the global level. Our baseline source of information on the price of private investment and private consumption goods is the Penn World Tables (PWT, mark 7.0). Since the PWT data are converted using purchasing power parity exchange rates, which is undesirable for our exercise, we follow Restuccia and Urrutia (2001) and use the PWT's relative investment good price in each country divided by this same ratio in the United States. We then multiply this by the ratio of the investment deflator to the personal consumption expenditure deflator for the United States, obtained from the BEA, to calculate a relative price of investment measured at domestic prices. To corroborate the PWT data, some of our analyses also look at trends in the ratio of the fixed investment deflator to the consumer price index, where the data are obtained for each country from the Economist Intelligence Unit (EIU).

Figure 7 plots changes over time in the global GDP-weighted averages of these measures together with the global corporate labor share. All series clearly decline together starting around the early 1980s.[10] We generally start our analyses in 1975 because prior to that the sample includes a significantly smaller set of countries and is meaningfully impacted by changes in composition as countries enter. Though that caveat remains important, Figure 7 highlights that there is strong positive comovement between the price of investment goods and the labor share at the global

[10]Our model assumes that the decline in the price of investment goods is driven by supply (e.g. increasing openness to international trade and growth in the information and communication technology industry). While we do not seek to explain the global or cross-country patterns in the relative price of investment, we note that demand-driven declines in the price of investment goods would be associated with decreasing corporate labor shares, savings, and investment. See Greenwood, Hercowitz, and Krusell (1997), Fisher (2006), and Justiniano, Primiceri, and Tambalotti (2011) for discussions of investment-specific technological change in the United States.

level even when considering time series with 60 years of data.

These global patterns are suggestive, but we now turn to the cross-country relationship between trends in the relative price of investment goods and trends in the corporate labor share from 1975-2007, which we will use to calibrate our model in Section 4.1. Figure 8 plots estimated trends in labor shares against those in relative investment prices for all countries with at least 10 years of data, with the trend coefficients scaled to equal the average change per 10 years. The plot shows a clear positive relationship with a slope coefficient equal to 0.207 and with a p-value of 0.02. We use this cross-sectional relationship to estimate an elasticity of substitution between labor and capital in the production function that exceeds unity.[11]

In Appendix B, we present various robustness exercises. First, we present evidence that changing industrial composition cannot on its own explain the decline in the labor share as the trend is found strongly within the manufacturing and trade, transport, and communications sectors, and is also found, to a smaller extent, within the finance and construction sectors. Second, we repeat our cross-sectional regressions for the countries that have at least 15 years of data, which eliminates 21 of the least developed countries in our sample. Third, we repeat our cross-sectional regressions using investment price data from the EIU. Finally, we examine the cross-sectional relationship between trends in labor shares and corporate income taxes (that have fallen significantly for many countries). All exercises yield results highly similar to our base results.

To summarize, labor shares in the corporate sector have been declining throughout the world over the last 30 years. This has been true in the world's largest economies such as the United States, China, Japan, and Germany, but also holds true for most developing countries for which we have data. We provide evidence that declining labor shares are related to declines in the relative price of investment using both time series and cross-sectional variation.

## 2.3 The Global Rise of Corporate Savings

Trends in corporate savings shares, like trends in labor shares, have been broad-based. In Figure 9 we present the estimated coefficients on linear trends in corporate savings relative to total savings for all 44 countries with more than 10 years of data. 30 of these countries exhibit increases in the share of corporate savings. Of the 31 countries with statistically significant trends, 22 of these were positive, including all of the largest 8 economies highlighted in red.

[11] This relationship is also found using within-country time series variation. We measure the semi-elasticity of the labor share with respect to the relative price of investment for each country and find a median value of 0.26 with a bootstrapped p-value of 0.01. We prefer to calibrate the production function using the cross section of *trends* as this allows for permanent differences in labor shares due to measurement practices or industrial composition. However, we get similar results when we estimate the cross-sectional relationship between *levels* of relative investment prices and labor shares. For instance, the slope is 0.12 in 1980 and 0.21 in 1990.

The corporate savings share for the global aggregate plotted in Figure 1 increases by 16.1 percentage points between 1975 and 2007. This estimate differs somewhat from our baseline estimate of a 20 percentage point decline in large part due to changes in country composition of our dataset. To obtain our baseline estimate, we run the same four regressions with time and country fixed effects as we did to obtain our baseline estimate of the change in the global corporate labor share. The four specifications differ in their treatment of weights and countries included in the sample, but produce estimates of the increase in corporate savings as a share of total savings equal to 21, 23, 17, and 25 percentage points.

In our model, firms increase investment in response to declining investment prices, and the degree to which investment is funded by corporate savings depends on the strength of capital market imperfections. In parallel to the cross-sectional relationship used to calibrate the production function, Figure 10 plots trends in corporate savings as a share of total savings against trends in relative investment prices, where we include all countries with at least 10 years of observations. The plot shows a clear negative relationship with a slope coefficient equal to -0.46 and with a p-value of 0.07.[12] In our model, we use this relationship to calibrate imperfections in the capital market. In Appendix B, we report the robustness of this cross-sectional relationship to alternative methods for constructing our dataset as well as to the use of alternative proxies for changes in the user cost of capital such as EIU investment prices and corporate tax rates.

To relate changes in corporate savings more explicitly to the labor share, we decompose the corporate savings rate as:

$$\frac{S_C}{Y} = \frac{Q_C}{Y}\frac{\Pi_C}{Q_C}\left(1 - \frac{d_C}{\Pi_C}\right) = \frac{Q_C}{Y}\left(1 - s_{L,C} - s_{K,C}\right)\left(1 - \frac{d_C}{\Pi_C}\right). \tag{5}$$

Corporate savings will rise relative to GDP as the corporate sector increases as a share of economic activity, as the labor or the capital share declines, and as dividends decrease relative to profits. Note that corporate savings as a share of total aggregate savings $S_C/S$ can be similarly decomposed because it simply equals the ratio in (5) divided by the global savings rate $S/Y$, which is largely stable over the time period we consider. Equation (5) is an accounting identity, and therefore the above analysis links the global decline in the labor share to the global rise in corporate savings, regardless of the cross-country composition of these changes. Nonetheless, we note that the majority of countries in our data either experienced both a decline in their labor share and a rise in corporate savings or experienced the reverse.

[12] This relationship is also found using within-country time series variation. We measure the semi-elasticity of the corporate savings share with respect to the relative price of investment for each country and find a median value of -0.49 with a bootstrapped p-value of 0.01.

We add all countries with data on each of the three terms in equation (5) and plot (in logs) their evolution in Figure 11, where all series are normalized to zero in 1975. The solid line shows a roughly 0.3 log point increase in global corporate savings relative to GDP, the left-hand-side of equation (5). This increase, by definition, must equal the sum of log changes in corporate value added relative to GDP ($Q_C/Y$), corporate profits relative to value added ($1 - s_{L,C} - s_{K,C}$), and the share of corporate profits that are retained ($1-d_C/\Pi_C$). The dashed line shows that there was essentially no change in corporate value added relative to GDP. The increase in corporate savings resulted from the large increase in corporate profits, plotted with the long-dashed line, which itself resulted in large part from the decline in the labor share. A decline in the capital share also made an important contribution. Dividend payments increased, as shown by the declining short-dashed line, but this increase did not fully absorb the increase in profits.

Studying labor shares and corporate savings jointly is important in part because it disciplines the type of shocks that can explain their large movements in the data. Our decomposition in equation (5) makes clear that corporate savings and labor shares are integrally related, but need not move in opposite directions. For example, reductions in competition might increase markups and generate a reduction in the labor share. This explanation, however, would likely lower investment rates and increase dividends to an extent that the corporate savings share would decline. The mechanism highlighted by our model generates movements in profit, labor, and savings shares consistent with those plotted in Figure 11.

To summarize, corporate labor shares around the world declined over the last three decades. The scale of the corporate sector relative to GDP has not changed, other payments to capital have declined as a share of corporate value added, and there has only been a moderate increase in dividends relative to profits. As a result, there has been a significant increase in corporate savings relative to GDP and relative to total savings. Both trends were strongest in countries with larger declines in the relative price of investment goods.

# 3 CES Production and Capital Market Imperfections

We develop a general equilibrium economy consisting of a representative household, a government, and a unit measure of ex-ante heterogeneous corporations owned by the household. Time is discrete and the horizon is infinite, $t = 0, 1, 2, ...$ We present several details of the model (such as first-order and equilibrium conditions, derivations, and the numerical procedure we followed to solve the model) in Appendix C.

There is neither aggregate nor idiosyncratic uncertainty and all economic agents have perfect foresight. Corporations are heterogeneous with respect to their productivity $z$ which is constant over time and distributed according to the density function $\pi(z)$. All firms produce a homogeneous good and aggregate final output is allocated between the consumption expenditures of the household and the government and the investment expenditures of the household and corporations. The household saves to smooth its consumption over time and to self-finance its investment in household capital (e.g. housing) which yields utility. Corporations save to self-finance their investment in corporate capital such as equipment or software, which yields output and profits consistent with the maximization of the firm's value to shareholders.

Two elements differentiate our model from the standard neoclassical growth model. First, we calibrate a CES production function that results in fluctuations in the labor share. Second, capital market imperfections that restrict the flow of funds between the household and corporations imply that the sectoral composition of savings is informative about macroeconomic allocations.

## 3.1 Household Sector

The representative household chooses consumption $c_t$, labor supply $n_t$, corporate bonds $b^c_{t+1}(z)$, government bonds $b^g_{t+1}$, holdings of corporate shares $\theta_{t+1}(z)$, household investment $x^h_t$, and housing capital $k^h_{t+1}$ in order to maximize the discounted sum of utilities:

$$\max_{\{c_t,n_t,b^c_{t+1}(z),b^g_{t+1},\theta_{t+1}(z),x^h_t,k^h_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left(U\left(c_t\right) - N\left(n_t;\chi_t\right) + H\left(k^h_t;\nu_t\right)\right), \tag{6}$$

where $\beta \in (0,1)$ is the discount factor. We let $\chi_t$ and $\nu_t$ denote exogenous shifts in the preference for work and for household capital. Consumption is our numeraire.

Following Greenwood, Hercowitz, and Krusell (1997), investment expenditures of $x^h_t$ units of the final good yield $x^h_t/\xi^h_t$ units of capital. These units are used to augment the household capital stock and to cover adjustment costs equal to $\Psi^h(k^h_{t+1},k^h_t)$. The exogenous variable $\xi^h_t$ denotes the efficiency of household investment, with lower $\xi^h_t$ denoting a higher efficiency. Letting $\delta^h$ denote the depreciation rate of household capital, the capital accumulation equation is:

$$k^h_{t+1} = (1-\delta^h)k^h_t + \frac{x^h_t}{\xi^h_t} - \Psi^h(k^h_{t+1},k^h_t). \tag{7}$$

In equilibrium, the household owns all corporate shares, so $\theta_t(z) = 1$ for all $t$ and $z$. Let $p_t(z)$ be the ex-dividend equity value of a corporation with productivity $z$ during period $t$. In period $t$, the corporation can issue new equity or repurchase existing shares with a value denoted by $e_t(z)$ (where $e_t(z) < 0$ for repurchases). Capital gains inclusive of the impact of dilution and repurchases, $p_t(z) - p_{t-1}(z) - e_t(z)$, are taxed at a rate $\tau_t^g$.[13] During period $t$ the household receives dividends $d_t(z)$ from ownership of a corporation of type $z$. Dividends are taxed at a rate $\tau_t^d$. Therefore, the total dividend income tax liability of the household in period $t$ from holding shares of corporation $z$ is $\tau_t^d d_t(z)\theta_t(z)$.

The household earns a wage $w_t$ in a competitive labor market. Labor income is taxed at a rate $\tau_t^n$. The household chooses to hold one-period corporate bonds $b_{t+1}^c(z)$ and one-period government bonds $b_{t+1}^g$. All bonds cost one unit of the consumption good and pay a common risk-free interest rate $r_{t+1}$ in the next period. From the point of view of the household, corporate and government bonds are perfect substitutes. Interest income is taxed at a rate $\tau_t^k$. The depreciation of household capital is deducted from personal interest income taxes. Finally, the household receives lump sum transfers $T_t$ from the government. The household's budget constraint is:

$$\begin{aligned} c_t + x_t^h + b_{t+1}^g + \int \big(p_t(z)\theta_{t+1}(z) + \tau_t^g\left(p_t(z) - p_{t-1}(z) - e_t(z)\right)\theta_t(z) + b_{t+1}^c(z)\big)\,\pi(z)dz = \\ \int \big(\left((1-\tau_t^d)d_t(z) + p_t(z) - e_t(z)\right)\theta_t(z) + (1 + r_t(1-\tau_t^k))b_t^c(z)\big)\,\pi(z)dz + \\ (1 + r_t(1-\tau_t^k))b_t^g + T_t + \tau_t^k\delta^h k_t^h + (1-\tau_t^n)w_t n_t. \end{aligned} \tag{8}$$

## 3.2 Corporate Sector

Corporations produce final output $Q_t$ with labor $n_t$ and corporate capital $k_t^c$ according to the production function $Q(k_t^c, n_t; A_t, z)$. Since corporations own the capital stock (instead of renting it), $Q_t$ denotes corporate gross value added.[14] We denote by $z$ and $A_t$ the firm-specific and aggregate levels of factor-neutral productivity. When no ambiguity arises, we typically omit the argument $z$ in describing an individual firm's problem.

Firms operate a CES production technology:

$$Q_t = zA_t\left(\alpha_k^{\frac{\sigma-1}{\kappa\sigma}}\left(k_t^c\right)^{\frac{\sigma-1}{\sigma}} + \alpha_n^{\frac{\sigma-1}{\kappa\sigma}} n_t^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\kappa\sigma}{\sigma-1}}, \tag{9}$$

where $\kappa \leq 1$ is the returns to scale parameter, $\sigma > 0$ is the elasticity of substitution between capital and labor, and $\alpha_k$ and $\alpha_n$ are parameters which we later calibrate to match the average labor share in corporate income. The choice of a CES technology with elasticity greater than one rather than a Cobb-Douglas technology (with an elasticity equal to one) is essential for producing movements in the labor share which, in turn, produce larger movements in corporate savings. The

[13]For tractability, we follow Poterba and Summers (1983) and assume that capital gains are taxed on accrual rather than on realization.

[14]$Q_t$ in the model is what we called $Q_C$ in the empirical analysis for the corporate sector. Similarly, we drop the $C$ subscript for dividends, profits, and all variables when it does not produce ambiguity.

firm demands labor up to the point where the marginal product of labor equals the wage, yielding a labor demand function. We define the corporate gross operating surplus $y_t$ as the difference between output and payments to labor, $y_t = Q(k_t^c, n_t; A_t, z) - w_t n_t$. The corporate labor share is defined as $s_{L,t} = w_t n_t / Q_t$.

Corporate capital evolves identically to household capital, but with investment efficiency, capital adjustment costs, and depreciation rates specific to the corporate sector:

$$k_{t+1}^c = (1-\delta^c)k_t^c + \frac{x_t^c}{\xi_t^c} - \Psi^c(k_{t+1}^c, k_t^c). \tag{10}$$

We treat $\xi_t^c$ as representing the relative price of corporate investment. We calibrate its movement using the empirical analyses reported in Figures 7, 8, and 10.

Following Gomes (2001) and Hennessy and Whited (2005), equity financing is costly because of asymmetric information or transaction costs. Specifically, we assume that there exists an intermediary firm ("bank") that channels equity flows from the household to the firm. For each unit of new equity raised ($e_t > 0$) in period $t$, only $\lambda e_t$ units actually augment the firm's funds, where $\lambda \in [0,1]$. In other words, $(1-\lambda)e_t$ units are paid to the bank in "flotation costs." We write the equity raised or repurchased by a corporation as $E(e_t) = \min\{e_t, \lambda e_t\}$ and therefore $e_t - E(e_t)$ represents flotation costs. Flotation costs are rebated back to the household.

In each period $t$, the flow of funds constraint for a corporation is:

$$x_t^c + d_t + (1+r_t)b_t^c = (1-\tau_t^c)y_t + \tau_t^c\left(\delta^c k_t^c + r_t b_t^c\right) + b_{t+1}^c + E(e_t). \tag{11}$$

The left hand side of the flow of funds equation denotes the uses of funds. The corporation purchases capital goods $x_t^c$, distributes dividends $d_t$, and repays principal and interest on its debt $(1+r_t)b_t^c$. The right hand side of the flow of funds equation denotes the sources of funds. The corporation earns a gross operating surplus $y_t$ which is taxed at a rate $\tau_t^c$, issues debt $b_{t+1}^c$, issues or repurchases equity $E(e_t)$, and finally receives a tax shield due to the expensing of capital depreciation and debt interest payments.

Corporate profits equal gross operating surplus, less corporate taxes and equity flotation costs, less interest payments on debt, net of tax reductions from expensing interest payments and depreciation:

$$\Pi_t = y_t\left(1-\tau_t^c\right) - \left(e_t - E\left(e_t\right)\right) - r_t b_t^c\left(1-\tau_t^c\right) + \tau_t^c \delta^c k_t^c. \tag{12}$$

Corporate savings equals corporate profits less dividends paid, $S_t^c = \Pi_t - d_t$. Substituting into equation (11), one thus sees that corporate investment is funded by corporate savings plus equity issuance plus new net bond issuance: $x_t^c = S_t^c + e_t + \left(b_{t+1}^c - b_t^c\right)$.

Corporations are subject to the following financial constraints:

$$d_t \geq 0, \tag{13}$$

$$(1 + r_{t+1})b_{t+1}^c \leq \eta k_{t+1}^c, \tag{14}$$

$$e_t \geq -\left(e^0 + e^1 k_t^c\right). \tag{15}$$

Constraint (13) requires that corporations cannot distribute negative dividends to increase corporate savings without limits. Constraint (14) limits debt with a collateral constraint as in Kiyotaki and Moore (1997) and Hennessy and Whited (2005). Given the tax shield on corporate debt, the collateral constraint always binds. Corporations may not default on their debt.

The crucial constraint in our model is (15). As we discuss below, firms in our model prefer transferring value to shareholders with equity buybacks rather than by dividends because the dividend tax is higher than the capital gains tax. For this reason, some repurchases by U.S. firms may lead the Internal Revenue Service to treat them as dividends. As such, we follow Poterba and Summers (1985) and Gourio and Miao (2011) and introduce a lower bound on $e_t$ to limit the magnitude of repurchases and capture this regulatory constraint.

While we call negative values of $e_t$ equity repurchases, we think of $e_t < 0$ more broadly as capturing all pre-dividend distributions or transactions affecting the net lending position of the corporate sector. For instance, issuance of corporate debt net of purchases of government bonds or other assets in steady state can be thought as being captured by the $e_t$ variable. When the parameter $e^0$ in the constraint (15) increases, the level of corporate savings in the economy increases because a larger amount of these alternatives to dividend payments are allowed. We calibrate $e^0$ to match the dividend to profit ratio (which affects the level of corporate savings). When $e^1$ increases, corporate savings increase more in response to a given decrease in the user cost of capital. We calibrate $e^1$ to match the cross-sectional relationship between trends in corporate savings shares and trends in the relative price of investment goods. An increase in $e^1$ lowers the user cost of capital and increases desired investment. As a result, through constraint (15), corporate savings become informative about corporate investment.

In each period $t$ a corporation of type $z$ chooses labor demand $\{n_s\}_{s=t}^{\infty}$, an investment policy $\{x_s^c\}_{s=t}^{\infty}$, a debt policy $\{b_{s+1}^c\}_{s=t}^{\infty}$, a dividend policy $\{d_s\}_{s=t}^{\infty}$, and an equity policy $\{e_s\}_{s=t}^{\infty}$ that maximize the value of shares owned by the existing shareholders in the beginning of period $t$, including the concurrent after-tax distribution of dividends. To value the corporation we use the fact that the household is willing to hold equity only if the after-tax return to equity equals the after-tax return to other uses of funds (since there is no uncertainty we have no equity premium). The value of the firm $V_t$ can be expressed as:

$$V_t = \max_{\{n_s, d_s, e_s, b^c_{s+1}, k^c_{s+1}, x_s\}_{s=t}^{\infty}} \sum_{s=t}^{\infty} \beta^c_s \left( \left( \frac{1-\tau^d_s}{1-\tau^g_s} \right) d_s - e_s \right), \tag{16}$$

where we define:

$$\beta^c_{t+s} = \frac{1}{\prod_{j=0}^{s} \Gamma_{t+j}}, \quad \Gamma_{t+s} = 1 + \left( \frac{1-\tau^k_{t+s}}{1-\tau^g_{t+s}} \right) r_{t+s}, \quad \text{and } \beta^c_t = 1, \quad \forall s > 0,$$

subject to the capital accumulation constraint (10), the flow of funds constraint (11), and the financial policy constraints (13)-(15). We let $\beta^c_t q_t$, $\beta^c_t \mu^d_t$, $\beta^c_t \mu^b_t$, and $\beta^c_t \mu^e_t$ be the period-$t$ multipliers on the capital accumulation constraint, the dividend constraint, the debt constraint, and the equity repurchase constraint respectively. The coefficient on dividends in the objective function of the corporation reflects the fact that with differential dividend and capital gains tax rates, shareholders do not value a unit of dividends equally to a unit of equity repurchases. To produce well-defined solutions to corporate financial policy, we assume that $\tau^d_t > \tau^g_t$. Note here that $\beta^c_t$ evolves endogenously and captures the important general equilibrium element that households will value payouts more in some periods and less in others.

We let $Q_{k,t+1}(.)$ denote the marginal product of capital in period $t+1$ and define the firm's user cost of capital as:

$$u_{t+1} = (1 - \tau^c_{t+1}) Q_{k,t+1}. \tag{17}$$

To summarize the most important intuitions of corporate investment and financial policy, here we assume that there are no adjustment costs, no corporate bonds, no taxes on corporate profits, capital gains, or interest income, that dividend taxes and the price of investment goods are always constant, and that the equity repurchase constraint is $e_t \geq -e^0$. Under these simplifying assumptions, the optimal corporate capital stock is determined by the condition:

$$Q_{k,t+1} = (1 + r_{t+1}) \left( \frac{1 - \tau^d + \mu^d_t}{1 - \tau^d + \mu^d_{t+1}} \right) - (1 - \delta^c). \tag{18}$$

If the multiplier on the dividend constraint were constant, the optimal next-period capital stock $k^c_{t+1}$ would also be constant at a level such that the marginal product of capital $Q_{k,t+1}$ equals the user cost $(r_{t+1} + \delta^c)$. Intuitively, in the absence of financial constraints and without any capital adjustment costs, the firm always chooses its investment to hit some target capital stock that is determined by the interest rate, depreciation, and technology. Figure 12 shows the firm's decision rules as a function of initial capital stock $k^c_t$ under our simplifying assumptions.

The left panel shows that the policy function for $k^c_{t+1}$ is not completely flat, revealing that the dividend multiplier $\mu^d_t$ changes as we vary $k^c_t$.

As shown in the middle panel of Figure 12, our model embodies a "pecking order" for sources of corporate finance. When the firm starts with a low capital stock $k^c_t$ (region A in the figure), it will issue equity to invest and reach a higher level of capital stock as determined by equation (18). Note that in this region, the multipliers are such that $\mu^d_t > \mu^d_{t+1} > 0$, which raises the user cost of capital relative to the case in which the firm always pays dividends. At some levels of the capital stock (region B), the firm is rich enough that, to avoid paying flotation costs, it finances higher investment with internal funds rather than with new equity. The optimal capital stock $k^c_{t+1}$ therefore increases in $k^c_t$, as shown in the left panel of the figure.

As $k^c_t$ increases further (region C), the firm distributes resources back to the shareholders. Because dividends have a tax disadvantage relative to capital gains, the firm will use each additional unit of cash from operating the capital stock $k^c_t$ to purchase back its equity ($e_t < 0$) until it hits the equity repurchase constraint $-e^0$. When dividend taxes are sufficiently high, there is another region (region D) in which additional units of capital $k^c_t$ are invested in increasing the physical capital stock $k^c_{t+1}$, before the firm distributes any dividends. Finally, when the firm is very rich, each additional unit of cash is distributed as dividends to the shareholders (region E). In this region, $k^c_{t+1}$ is determined as the solution to the equation that sets the marginal product of capital equal to the user cost of capital ($r_{t+1} + \delta^c$), as in a model without any financial constraints. The right panel of Figure 12 shows that the relationship between corporate savings and investment differs across the five regions and therefore depends on the constraints governing corporate financial policy.

## 3.3 Equilibrium

We denote government's spending by $G_t$. The government's budget constraint is:

$$\tau^n_t w_t n_t + \int \left(\tau^d_t d_t(s) + \tau^g_t \left(p_t - p_{t-1} - e_t\right) + \tau^k_t r_t b^c_t + \tau^c_t y_t + e_t - E(e_t)\right) \pi(z) dz =$$
$$G_t + T_t + (1 + r_t) b^g_t - b^g_{t+1} + \int \left(\tau^c_t \delta^c k^c_t + \tau^c_t r_t b^c_t\right) \pi(z) dz + \tau^k_t \delta^h k^h_t - \tau^k_t r_t b^g_t. \qquad (19)$$

The government taxes at a rate of 100 percent the revenues of the bank from intermediating equity flows and rebates the proceeds lump-sum to the household.

We define an equilibrium for this economy as a sequence of prices and quantities such that, given a sequence of exogenous variables: (i) taking prices as given, household policies maximize household's utility (6) subject to the budget constraint and the capital accumulation constraint;

(ii) taking prices as given, corporate policies maximize the value of the firm (16) subject to the flow of funds, the capital accumulation constraint, and the financial constraints; (iii) government transfers adjust to always satisfy the budget constraint (19); and (iv) labor, bond, equity, and goods markets clear in every date. We define a steady state as an equilibrium in which all variables are constant over time.

## 3.4 Perfect Capital Markets and Composition Neutrality of Savings

It is straightforward to evaluate the impact of the CES production function by comparing our results to the results in a model with Cobb-Douglas production. To evaluate the impact of capital market imperfections, we now develop a model with perfect capital markets. With perfect capital markets, an integrated unit, the "planner," maximizes household utility and operates firms' technologies by shifting resources freely across the two sectors. Comparing our model to the model with perfect capital markets illustrates the conditions under which the composition of savings between the corporate and household sectors is informative about macroeconomic outcomes. We refer to this concept as the "composition non-neutrality of savings."

In the perfect capital markets model, the planner is allowed to transfer resources $R_t(z)$ without cost between the corporate and household sectors. This implies that there is a single resource constraint:[15]

$$c_t + x_t^h + \int x_t^c(z)\pi(z)dz + b_{t+1}^g - (1 + r_t(1-\tau_t^k))b_t^g - T_t - \tau_t^k\delta^h k_t^h =$$
$$\int \left((1-\tau_t^c)\left(Q_t(k_t^c(z), n_t^c(z)) - w_t n_t^c(z)\right) + \tau_t^c\delta^c k_t^c(z)\right)\pi(z)dz + (1-\tau_t^n)w_t n_t^h. \tag{20}$$

The planner's problem in the economy with perfect capital markets is to choose the allocations to maximize household's utility (6) subject to the household capital constraint (7), the corporate capital constraint for each firm (10), and the planner's resource constraint (20).

Note that in the absence of capital market imperfections, this model – like the standard neoclassical growth model – does not admit a well defined notion of "corporate" and "household" savings. The variable $R_t(z)$ can be thought of either as corporate savings (or corporate gross disposable income) or as dividends distributed back to the household and therefore part of the household's gross disposable income. The sectoral composition of savings is not informative about macroeconomic outcomes because multiple possible observed compositions of national savings yield identical allocations in the economy.

[15]The planner chooses separately the supply $n_t^h$ and the demand $n_t^c$ for labor. This allows us to fix the government-induced distortions to be similar across the two models.

In Section 4, we explore the quantitative importance of the composition non-neutrality of savings and its relationship to the underlying parameters that summarize the imperfections in the capital market. Here, we summarize analytically the difference between our model and the alternative model with perfect capital markets by comparing the user cost of capital in the two models. For any corporation $z$ in the model with perfect capital markets the user cost is:

$$u_{t+1} = \xi_t^c \left(1 + \left(1 - \tau_{t+1}^k\right) r_{t+1}\right) \left(1 + \Psi_{1,t}^c\right) - \xi_{t+1}^c \left(1 - \left(1 - \frac{\tau_{t+1}^c}{\xi_{t+1}^c}\right) \delta^c - \Psi_{2,t+1}^c\right), \tag{21}$$

while in our baseline model with capital market imperfections, the user cost is:

$$\begin{aligned} u_{t+1} = \xi_t^c \left(1 + \left(\frac{1 - \tau_{t+1}^k}{1 - \tau_{t+1}^g}\right) r_{t+1}\right) \left(\frac{\frac{1-\tau_t^d}{1-\tau_t^g} + \mu_t^d}{\frac{1-\tau_{t+1}^d}{1-\tau_{t+1}^g} + \mu_{t+1}^d}\right) \left(1 + \Psi_{1,t}^c - \eta \mu_t^b\right) - \\ \xi_{t+1}^c \left(1 - \left(1 - \frac{\tau_{t+1}^c}{\xi_{t+1}^c}\right) \delta^c - \Psi_{2,t+1}^c\right) - \frac{\mu_{t+1}^e e^1}{\frac{1-\tau_{t+1}^d}{1-\tau_{t+1}^g} + \mu_{t+1}^d}. \end{aligned} \tag{22}$$

Comparing equation (21) to equation (22), and fixing tax rates to be constant over time, we see that capital gain taxes ($\tau_t^g$), evolving dividend multipliers ($\mu_t^d \neq \mu_{t+1}^d$), binding debt constraints ($\mu_t^b > 0$), and binding equity repurchase constraints that depend on the capital stock ($e^1 > 0$ and $\mu_{t+1}^e > 0$) introduce a wedge between the user cost of capital in the economy with imperfect capital markets and the user cost of capital in the economy with perfect capital markets. When user costs differ, the allocations between the two models will differ. As a result, in the model with imperfect capital markets corporate savings are not only well-defined but also informative about macroeconomic allocations.

# 4 Quantitative Results

In this section, we calibrate the CES model with imperfect capital markets and present our quantitative results.

## 4.1 Calibration

Each period in the model corresponds to a year. Whenever possible we calibrate the model to match moments of the global aggregate observed over our 1975-2007 sample. We summarize the calibrated parameters in Table 1. We remove time subscripts to denote steady state values of time-varying exogenous or endogenous variables. Here we describe the calibration of the key parameters, $\alpha_k$ and $\sigma$ in the production function (9) and $e^0$ and $e^1$ in the equity repurchase constraint (15). The calibration of all other parameters is standard and discussed in Appendix D.

The four parameters are calibrated to jointly match four moments in our global dataset. Two of the moments are associated with the labor share and the other two with corporate savings. Specifically, we target: (i) a steady state corporate labor share $s_L = 0.614$, which equals the global average of the corporate labor share in Figure 1; (ii) a cross-sectional relationship between trends in corporate labor shares and trends in the log of investment prices $\mathrm{d}\left(s_L\right)/\mathrm{d}\left(\log \xi^c\right) = 0.207$, equal to that documented in Figure 8; (iii) a steady state dividend to profit ratio of $d/\Pi = 0.279$, which equals the global average underlying the construction of corporate savings as a share of total savings in Figure 1; and (iv) a cross-sectional relationship between trends in corporate savings as a share of total savings and trends in the log of investment prices $\mathrm{d}\left(S^c/S\right)/\mathrm{d}\left(\log \xi^c\right) = -0.460$, equal to that documented in Figure 10. To generate the cross-sectional relationships in our model, we introduce a negative shock to the investment price $\xi^c$ and examine steady state to steady state changes in corporate labor shares and corporate savings shares. This yields the values $\alpha_k = 0.1329$, $\sigma = 1.422$, $e^0 = -0.0002$, and $e^1 = 0.0123$.

## 4.2 Steady State Results

The first column of Table 2 summarizes the steady state of the model with capital market imperfections.[16] As shown in Row (ii) of the table, corporations account for 66 percent of aggregate gross investment in the economy, a number close to the average value of 69 percent in our sample (after subtracting government investment). Row (iii) shows that the model produces a composition of savings that is more tilted towards corporations (roughly 80 percent) than what we observe in the data (around 55 percent). Similarly, the model exhibits an elevated level of corporate savings to GDP. These differences are to be expected, however, because our model does not contain unincorporated businesses nor do we have an elaborate description of the government sector.

Instead, we focus on successfully reproducing the relevant terms of the decomposition in equation (5), which expressed corporate savings relative to GDP as the product of three terms: the share of economic activity produced in the corporate sector $Q_C/Y$, the profit share $1-s_{L,C}-s_{K,C}$, and the fraction of corporate profits that are retained $1-d_C/\Pi_C$. Our model matches the data closely on both the profit share and the dividend to profits ratio. Therefore, differences in corporate savings shares in our model relative to the data appropriately reflect the fact that in the

[16] After calibrating our baseline model (CES model with imperfect capital markets), we normalize productivity $A$ in the Cobb-Douglas model so that the Cobb-Douglas model with imperfect capital markets shares the same initial steady state with the CES model with imperfect capital markets. This implies that the CES and the Cobb-Douglas model have different initial steady states only with perfect capital markets.

model almost 95 percent of GDP is produced within the corporate sector while the corresponding number in the data is only around 65 percent.

Row (xiii) shows that the steady state user cost of capital in the model with capital market imperfections is 7.2 percent, which is 16 percent higher than the user cost of capital in the model with perfect capital markets. Quantitatively, capital gains taxes account for most of this difference, since the equity buyback constraint tends to lower the user cost in the model with capital market imperfections and the dividend constraint matters only when it binds along the transitional dynamics. The increased user cost of capital explains the lower capital stock, consumption, investment, and GDP in the model with capital market imperfections relative to the model with perfect capital markets.

The second column of Table 2 reports steady state values in the CES model with capital market imperfections relative to the CES model with perfect capital markets. Similarly, the third column reports relative steady state values in the Cobb-Douglas model. As columns 2 and 3 show, the steady state gap between imperfect and perfect capital markets is larger in the CES model relative to the Cobb-Douglas model. This is because the higher user cost of capital under imperfect capital markets implies a larger decline in the steady state capital-to-labor ratio when the elasticity of substitution $\sigma$ is higher. A higher capital-to-labor ratio in our model generally implies higher GDP, corporate investment, and consumption.[17]

## 4.3 Negative Investment Price Shock

Having characterized the steady state of the calibrated model, we now consider how this steady state changes in response to a negative investment price shock. We focus on steady state to steady state comparisons because this requires no assumptions about agents' expectations regarding the in-sample and future path of the shock, the timing with which those expectations change, and the function for adjustment costs in capital accumulation. In Appendix E, we present the full transition path for the investment price shock and for the other shocks considered below.[18]

We feed into the model a decline in the price of investment $\xi^c$ from 1 in the initial steady state to 0.79 in the final steady state, which is consistent with the GDP-weighted average change in the relative price of investment observed over time in the PWT data. We compare the response

[17]Labor productivity is a function of the capital-to-labor ratio. Our preferences imply that substitution and income effects on labor supply from wage changes cancel out. Therefore, labor productivity is closely related to output.

[18]In general, we find that along the transition from 1975 to 2007, the model generates roughly half of the responses that the steady state to steady state comparisons generate. It is not surprising that responses are muted relative to the steady state to steady state comparisons given that the model's transition to the final steady state takes significantly more than 33 years.

to this shock in four models. The models either feature Cobb-Douglas or CES production and either have perfect or imperfect capital markets. Our two-sector version of the neoclassical growth model features Cobb-Douglas production and has perfect capital markets. The baseline model presented above departs from the neoclassical model both because of CES production and because of capital market imperfections. The two other models introduce separately our two departures.

The last column of Table 3 shows the steady state to steady state change in key variables of our baseline model with CES production and capital market imperfections following the $\xi^c$ shock. Our model produces a 5.3 percentage point decrease in the labor share. The CES model without capital market imperfections, shown in the penultimate column, generates a 5.8 percentage point decline in the labor share because the relative input price (the wage divided by the user cost of capital) increases by even more than in our baseline model. By contrast, in the two models with Cobb-Douglas production, the labor shares are constant. Corporate savings in our model increases by 11.8 percent as a share of total savings, significantly more than the 7.2 percentage point increase in the Cobb-Douglas model with capital market imperfections.

Table 3 highlights the important interaction between the non-unitary elasticity of substitution and capital market imperfections introduced jointly in one model. For example, Row (xi) shows that in the Cobb-Douglas economy, the corporate capital stock increases by only 0.019 log points more in the model with perfect capital markets relative to the model with capital market imperfections. By contrast, in the CES economy the corporate capital stock increases by 0.059 log points more in the model with perfect capital markets relative to the model with capital market imperfections. As a result, differences in consumption and GDP growth between the two Cobb-Douglas economies equal 0.001 and 0.008 log points, whereas in the two CES economies they differ by 0.025 and 0.045 log points. In Section 4.5 we highlight that the interaction between capital markets imperfections and the shape of the production function applies more broadly in response to other shocks.

The comparison between the four models in Table 3 quantifies the effect of ignoring the information contained individually or jointly in the two key global trends documented in Figure 1. Our baseline results are from a model calibrated to a cross-sectional slope between trends in labor shares and trends in log investment prices equal to $\mathrm{d}\left(s_L\right)/\mathrm{d}\left(\log \xi^c\right) = 0.207$ and a cross-sectional slope between trends in corporate savings shares and trends in log investment prices equal to $\mathrm{d}\left(S^c/S\right)/\mathrm{d}\left(\log \xi^c\right) = -0.460$. We now instead consider how the economy's response would change if we hypothetically observed and calibrated our model to different cross-sectional relationships in these trends in our data.

Figure 13 shows the steady state to steady state growth in GDP for the various calibrations of our model in response to the same negative investment price shock as in our baseline results.[19] We plot GDP growth for these hypothetical calibrations relative to growth in calibrations targeting $\mathrm{d}\left(S^c/S\right)/\mathrm{d}\left(\log \xi^c\right) = -0.460$. This allows us to highlight the quantitative interaction of the two calibrated moments. Consider first the solid line which represents the Cobb-Douglas calibration ($\sigma = 1$) that we would choose if we hypothetically observed no cross-sectional relationship between labor shares and investment prices. In response to the negative investment price shock, this economy generates GDP growth that is 1.2 percentage point higher when also calibrated to match our actual estimated relationship between corporate savings and investment prices than when calibrated to target a hypothetical lack of correlation between corporate savings and investment prices in the cross section. By contrast, consider the models represented along the bottom line in the plot, which are calibrated to match a hypothetical cross-sectional relationship between labor shares and investment prices equal to $\mathrm{d}\left(s_L\right)/\mathrm{d}\left(\log \xi^c\right) = 0.414$ (corresponding to $\sigma$ roughly equal to 1.8). This model generates 2.2 percentage points more GDP growth when calibrated to match our actual estimated relationship between corporate savings and investment prices than when calibrated to target a hypothetical situation in which corporate savings and investment prices are uncorrelated in the cross section. On the other hand, as Figure 13 shows, there seems to be negligible variation in GDP growth across different labor share and investment price relationships as we calibrate the models to target slopes of corporate savings on investment prices that exceed our benchmark estimate of -0.46.

To summarize, these exercises corroborate our central point that declines in the labor share and increases in the corporate savings share were both driven in large part by declines in the relative price of investment. Further, information contained in these trends matters quantitatively for understanding the economy's response to these declines.

## 4.4 Can Our Model Reproduce the Global Empirical Patterns?

Our general equilibrium framework allows us to assess how household savings and investment decisions respond to shocks in the corporate sector. For instance, the fourth column of Row (vii) of Table 3 shows that, in response to the decline in the price of investment goods, total savings grow by 4 percentage points relative to GDP. While the household net borrowing position

[19] In all calibrations, we simultaneously vary all four parameters $\alpha_k$, $\sigma$, $e^0$, and $e^1$, to target a steady state labor share of 0.614, a steady state dividend to profit ratio of 0.279, and various combinations of $\mathrm{d}\left(s_L\right)/\mathrm{d}\left(\log \xi^c\right)$ and $\mathrm{d}\left(S^c/S\right)/\mathrm{d}\left(\log \xi^c\right)$. In Appendix E, we show how different combinations of $\mathrm{d}\left(s_L\right)/\mathrm{d}\left(\log \xi^c\right)$ and $\mathrm{d}\left(S^c/S\right)/\mathrm{d}\left(\log \xi^c\right)$ impact the model-generated analog of the sectoral version of the Feldstein and Horioka (1980) puzzle shown in Figure 3. A given relationship between corporate investment rates and corporate savings rates could be the product either of a high elasticity of substitution economy with low capital market imperfections or the product of a low elasticity of substitution economy with higher capital market imperfections.

deteriorates from 3 to 5 percent of GDP, household savings in our model do not offset one-to-one higher corporate savings to stabilize total savings to GDP because households are wealthier and invest more in household capital in the new steady state. In the data, however, household savings as a share of global GDP decreased and total savings as a share of global GDP remained roughly constant between 1975 and 2007. (In fact, the global savings rate declined slightly over this period, but for our purposes here it is sufficient and clearer to focus on its relative stability.) Interpreted through our model, this implies there were additional shocks beyond just the reduced investment price influencing these trends. In this sub-section, we emphasize the cross-sector feedback in our general equilibrium model and assess the extent to which our model can match the changing composition of savings observed in the data while maintaining a stable level of total savings to GDP.

To generate the reduction in household savings rates found in the data and needed to stabilize the overall savings rate, we now add additional shocks to the $\xi^c$ shock described above. The first column of Table 4 again lists how key statistics of our model change in response to the $\xi^c$ shock. The second column shows steady state to steady steady changes if, in addition to the $\xi^c$ shock, we introduce a negative shock to the depreciation rate on household capital $\delta^h$. Since households save in part to replenish depreciated capital, we calibrate a change in $\delta^h$ to offset the increase in aggregate savings coming from the decline in $\xi^c$. Alternatively, one can think that the household's discount factor $\beta$ decreased. This experiment is reported in the third column. In this exercise we also reduce the tax on interest payments $\tau^k$ to reverse the resulting increase in the real interest rate (the real interest rate also does not exhibit a trend in our global data from 1975-2007).

Rows (i) and (ii) show that both experiments produce movements in the corporate labor share and corporate savings shares consistent with the movements in the global aggregate constructed in our data and listed in the final column.[20] The discount factor shock is different from the depreciation shock because the former also affects the corporate user cost of capital. With the household depreciation shock, the labor share declines by 5.3 percentage points and the corporate savings share increases by 23.8 percentage points. With the discount factor shock, the labor share declines by 3.3 percentage points and the corporate savings share increases by 11.4 percentage points. In all these experiments, total savings over GDP and the real interest rate are by construction held constant.

In addition to the price of investment goods, other components of the user cost such as

[20] We consider changes for this "global aggregate" to be appropriate benchmarks because our global shocks are similarly constructed and ignore the impact of changing composition in our dataset. We remind the reader that our baseline results from fixed effects regressions offer an alternative benchmark for comparison and imply a decline in global labor share of 5 percentage points and a rise in global corporate savings share of 20 percentage points.

corporate income taxes $\tau^c$, dividend taxes $\tau^d$, and capital gain taxes $\tau^g$ have all declined globally over the last 30 years. Therefore, in the fourth column of Table 4, we introduce the $\xi^c$ shock simultaneously with a reduction of the corporate income tax rate of roughly 10 percentage points, as calculated from OECD data. In the fifth column we further add 30 percentage point declines in dividend and capital gains tax rates, as is consistent with the OECD data. As before, in both cases we add shocks to the discount factor and the tax rate on interest income to stabilize total savings as a share of GDP and the real interest rate.[21] In all cases, the decrease in the user cost of capital produces even larger declines in labor shares and larger increases in corporate savings shares. Detailed analyses of the transition path in response to all shocks given in each column of Table 4 can be found in Appendix E. We interpret these results as confirming that our model can indeed reproduce the global patterns focused on in Figure 1 and discussed above.

## 4.5 Broader Macro Implications

The information contained in trends in labor shares and corporate savings shares allows us to calibrate the production function and capital market imperfections which govern the economy's response to shocks. Thus far we have focused on the relevance of this information for understanding the response to the investment price shock experienced globally over the last 30 years. Now, we generalize our analysis to highlight that the information contained in trends in labor and corporate savings shares is important for the economy's response to a broader class of shocks.

As before, we compare the response of the four models listed in Table 3 (CES or Cobb-Douglas, and perfect or imperfect capital markets). This allows us to quantify the effects of capital market imperfections on the growth of various macroeconomic objects such as GDP, consumption, and welfare as a function of the shape of the production function. In our model the growth in these objects is closely related to the growth in the capital-to-labor ratio. For this reason, we now explicitly relate growth from the initial steady state in the capital-to-labor ratio in the model with imperfect capital markets (denoted by $I$) to growth in the capital-to-labor ratio in the model with perfect capital markets (denoted by $P$):

$$\frac{\mathrm{d}\left(k_I^c/n_I\right)/\left(k_I^c/n_I\right)}{\mathrm{d}\left(k_P^c/n_P\right)/\left(k_P^c/n_P\right)} = \left(1 - \frac{\left(u_R^{\sigma-1}-1\right)\left(1-s_{L,I}\right)}{s_{L,I}}\right)\left[1 - \left(\frac{1}{s_{L,P}}\right)\left(\frac{\sigma\left(\mathrm{d}u_R/u_R\right)}{\mathrm{d}\left(k_P^c/n_P\right)/\left(k_P^c/n_P\right)}\right)\right], \tag{23}$$

where $u_R = u_I/u_P > 1$ denotes the ratio of user costs in the models with imperfect capital markets

[21] We prefer adding a discount factor shock to the depreciation rate shock because the latter produces a decline in dividends relative to profits whereas the former produces an increase in dividends relative to profits. Figure 11 shows that dividends over profits increased in the data.

relative to the models with perfect capital markets, and $s_{L,I}$ and $s_{L,P}$ denote initial steady state values of the labor share in the models with imperfect and perfect capital markets respectively.[22]

A special but interesting case of equation (23) is obtained when shocks do not change the ratio of user costs ($\mathrm{d}u_R = 0$), which implies that the term in brackets equals one. For example, TFP shocks do not change $u_R$ from one steady state to another. As an illustration, we first consider an unanticipated and permanent increase in TFP by 20 percent relative to its initial steady state level. The dashed line in Figure 14(a) shows the difference between the growth in GDP with perfect capital markets and the growth in GDP with imperfect capital markets in the Cobb-Douglas economy ($\sigma = 1$). Substituting $\mathrm{d}u_R = 0$ and $\sigma = 1$ into equation (23) yields that growth in capital-to-labor ratios – and therefore growth in GDP – is not impacted by capital market imperfections for the Cobb-Douglas economy. Indeed, the dashed line converges to zero.

The solid line in Figure 14(a) plots the same growth difference in response to the same TFP shock but for the CES economy with our estimated elasticity $\sigma = 1.42$. In contrast to the Cobb-Douglas economy, the line always remains positive and indicates that market imperfections hinder the response of GDP to the shock. The result can be corroborated analytically by substituting $\mathrm{d}u_R = 0$ into equation (23). The term in parenthesis captures an interaction between the elasticity of substitution in the production function and the *level* of capital market imperfections. This term is less than one when $\sigma > 1$ which causes the capital-to-labor ratio to change in magnitude by proportionately less under imperfect capital markets. Therefore, in response to TFP increases, GDP growth under perfect capital markets exceeds GDP growth under imperfect capital markets. Further, equation (23) shows that, in response to shocks that increase the capital-to-labor ratio, as $\sigma$ increases the capital-to-labor ratio in the model with perfect capital markets grows by more relative to that in the model with imperfect capital markets.

Figure 14(b) considers the same comparison but in response to a decline in TFP of 20 percent. Capital market imperfections continue to have no effect on the long-run response of GDP in the Cobb-Douglas economy. In the CES economy, GDP declines more with perfect capital markets than with imperfect capital markets. Equation (23) shows that, in response to shocks that decrease the capital-to-labor ratio, as $\sigma$ increases the capital-to-labor ratio in the model with perfect capital markets declines by more relative to that in the model with imperfect capital markets.

Finally, consider the more general case in which shocks change the ratio of user costs ($\mathrm{d}u_R \neq 0$).

[22] In Appendix C we show how to derive this equation under the simplifying assumptions of constant returns to scale and a representative firm. We emphasize that the conclusions drawn below using equation (23) may apply more broadly than in our model because they reflect forces which emerge in any framework where frictions impact the level and growth of the user cost of capital.

The term in brackets will no longer equal one and the term $\sigma(\mathrm{d}u_R/u_R)$ shows explicitly the interaction between the elasticity of substitution in the production function and the *growth* of capital market imperfections. Various shocks change the ratio of user costs from one steady state to another. Examples include changes in household's discount factor $\beta$, changes in the corporate depreciation rate $\delta^c$, changes in parameters related to capital markets imperfections such as $e^1$ and $\eta$, and changes in the price of investment $\xi^c$. In the case of the $\xi^c$ shock focused on in the above sections, the ratio of user costs increases ($\mathrm{d}u_R > 0$). In this case, as the elasticity $\sigma$ increases, growth in the capital-to-labor ratio with perfect capital markets increases even more relative to that with imperfect capital markets.

# 5 Conclusion

For three decades, corporate labor shares have declined throughout the world. The resulting increase in global corporate profits was not offset by increased dividends payments. Therefore, the decrease in the share of income paid to labor generated a profound shift in the supply of global savings from households to corporations. These two trends were related, both across countries and over time, to a decline in the relative price of investment goods. All three patterns started or accelerated around 1980, and the magnitudes of the labor share and corporate savings trends were larger in countries experiencing larger relative investment price declines.

In standard macro models with perfect competition, the labor share is constant due to the Cobb-Douglas production function and the distinction between household and corporate savings is meaningless because households rent capital to firms in perfect capital markets. By contrast, we develop a model with CES production and capital market imperfections in which movements in the labor share and in the composition of savings across sectors are informative about macroeconomic outcomes. Calibrating our economy to the cross-section of countries, we show that the observed global decline in the price of investment explains a large fraction of observed labor share and corporate savings share trends. Studying the labor share and corporate savings jointly disciplines any explanation for either trend – our single shock can simultaneously produce both – and highlights the quantitatively and qualitatively important interaction between substitution elasticities and capital market imperfections for the behavior of the macroeconomy.

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| | Parameter | Value | Parameter | Value | Parameter | Value |
|---|---|---|---|---|---|---|
| **Preferences** | $\gamma$ | 1.0000 | $\rho$ | 1.0000 | $\phi$ | 1.0000 |
| | $\chi$ | 1.0000 | $\beta$ | 0.9723 | $\nu$ | 0.1218 |
| **Investment Technology** | $\delta^h$ | 0.0600 | $\bar{x}^h$ | 0.0600 | $\psi^h$ | 1.0800 |
| | $\delta^c$ | 0.0600 | $\bar{x}^c$ | 0.0600 | $\psi^c$ | 1.0800 |
| | $\xi^h$ | 1.0000 | $\xi^c$ | 1.0000 | | |
| **Government** | $G$ | 0.0000 | $b^g$ | 0.0000 | $\tau^c$ | 0.4400 |
| | $\tau^n$ | 0.2920 | $\tau^d$ | 0.4550 | $\tau^g = \tau^k$ | 0.3680 |
| **Production Technology** | $A$ | 0.1000 | $\alpha_n$ | 1.0000 | $\kappa$ | 0.9610 |
| | $\alpha_k$ | 0.1329 | $\sigma$ | 1.4220 | | |
| **Firm Heterogeneity** | $z_1$ | 1.0895 | $z_2$ | 0.9776 | | |
| | $\pi_1$ | 0.2000 | $\pi_2$ | 0.8000 | | |
| **Capital Market Imperfections** | $e^0$ | -0.0002 | $e^1$ | 0.0123 | | |
| | $\lambda$ | 0.9720 | $\eta$ | 0.2548 | | |

Table 1: Calibration

Notes: The table shows the parameter values of our baseline model with CES production function and imperfect capital markets. See Section 4.1 and Appendix D for details on the calibration.

| | Statistic | Steady State | CES: Imperfect / Perfect | CD: Imperfect / Perfect |
|---|---|---|---|---|
| (i) | Total Savings / GDP | 0.230 | 0.872 | 0.909 |
| (ii) | Corporate Investment / Total Investment | 0.660 | 0.921 | 0.942 |
| (iii) | Corporate Savings / Total Savings | 0.798 | — | — |
| (iv) | Dividends / Profits | 0.279 | — | — |
| (v) | Corporate Labor Share | 0.614 | 1.038 | 1.000 |
| (vi) | Corporate Debt / Capital | 0.239 | — | — |
| (vii) | Equity Repurchases / Profits | 0.125 | — | — |
| (viii) | Consumption | 0.255 | 0.925 | 0.938 |
| (ix) | GDP | 0.359 | 0.884 | 0.909 |
| (x) | Household Capital | 0.468 | 0.925 | 0.938 |
| (xi) | Corporate Capital | 0.907 | 0.710 | 0.778 |
| (xii) | Household / Corporate Capital | 0.516 | 1.302 | 1.205 |
| (xiii) | User Cost of Capital | 0.072 | 1.166 | 1.166 |
| (xiv) | Wage | 0.274 | 0.920 | 0.922 |

Table 2: Steady State Results

Notes: The first column lists steady state values in the model with imperfect capital markets. Steady state values with capital market imperfections coincide between the Cobb-Douglas and the CES models by appropriately normalizing the parameter $A$ in the Cobb-Douglas economy. The second column shows the ratio of steady state values with imperfect capital markets to steady state values with perfect capital markets in the CES model. The third column shows the ratio of steady state values with imperfect capital markets to steady state values with perfect capital markets in the Cobb-Douglas model.

| | Production Function: | CD | CD | CES | CES |
|---|---|---|---|---|---|
| | **Capital Market Imperfections:** | **No** | **Yes** | **No** | **Yes** |
| (i) | $\Delta$ Corporate Labor Share | 0.000 | 0.000 | -0.058 | -0.053 |
| (ii) | $\Delta$ Corporate / Total Savings | — | 0.072 | — | 0.118 |
| (iii) | $\Delta$ Corporate Savings / GDP | — | 0.031 | — | 0.064 |
| (iv) | $\Delta$ Corporate / Total Investment | 0.031 | 0.029 | 0.065 | 0.066 |
| (v) | $\Delta$ Corporate Investment / GDP | 0.023 | 0.018 | 0.058 | 0.044 |
| (vi) | $\Delta$ Corporate / Total Capital | 0.075 | 0.078 | 0.102 | 0.110 |
| (vii) | $\Delta$ Total Savings / GDP | 0.021 | 0.016 | 0.053 | 0.040 |
| (viii) | $\Delta$ log GDP | 0.202 | 0.194 | 0.317 | 0.272 |
| (ix) | $\Delta$ log Consumption | 0.174 | 0.173 | 0.242 | 0.219 |
| (x) | $\Delta$ log Labor | 0.015 | 0.011 | -0.012 | -0.017 |
| (xi) | $\Delta$ log Corporate Capital Stock | 0.561 | 0.542 | 0.823 | 0.764 |
| (xii) | $\Delta$ log Wage | 0.189 | 0.184 | 0.230 | 0.202 |
| (xiii) | $\Delta$ log User Cost | -0.357 | -0.347 | -0.357 | -0.347 |
| (xiv) | Welfare Equivalent Consumption | 0.204 | 0.205 | 0.321 | 0.290 |

Table 3: Response to a Negative Investment Price Shock (Steady State to Steady State)

Notes: The table shows the change in steady state values across the four models following the same shock to the relative price of investment goods $\xi^c$.

| | | $\Delta$ **in Response to the Following Shocks:** | | | | | $\Delta$ **in Data** |
|---|---|---|---|---|---|---|---|
| | | $(\xi^c)$ | $(\xi^c;\, \delta^h)$ | $(\xi^c;\, \beta, \tau^k)$ | $(\xi^c, \tau^c;\, \beta, \tau^k)$ | $(\xi^c, \tau^c, \tau^d, \tau^g;\, \beta, \tau^k)$ | **1975-2007** |
| (i) | Corporate Labor Share | -0.053 | -0.053 | -0.033 | -0.036 | -0.044 | -0.081 |
| (ii) | Corporate / Total Savings | 0.118 | 0.238 | 0.114 | 0.143 | 0.215 | 0.161 |
| (iii) | Corporate Savings /GDP | 0.064 | 0.055 | 0.026 | 0.033 | 0.050 | 0.039 |
| (iv) | Corporate / Total Investment | 0.066 | 0.161 | 0.062 | 0.085 | 0.146 | 0.091 |
| (v) | Corporate Investment / GDP | 0.044 | 0.037 | 0.014 | 0.020 | 0.034 | 0.025 |
| (vi) | Total Savings / GDP | 0.040 | 0.000 | 0.000 | 0.000 | 0.000 | $\approx 0$ |

Table 4: Explaining Declining Labor Shares and Rising Corporate Savings

Notes: The table shows the change in steady state values of the model with CES production and imperfect capital markets following the various shocks described in Section 4.4. "$\Delta$ in the Data" refers to the change in the global aggregate constructed by simply summing all variables in our data without correcting for changes in composition.

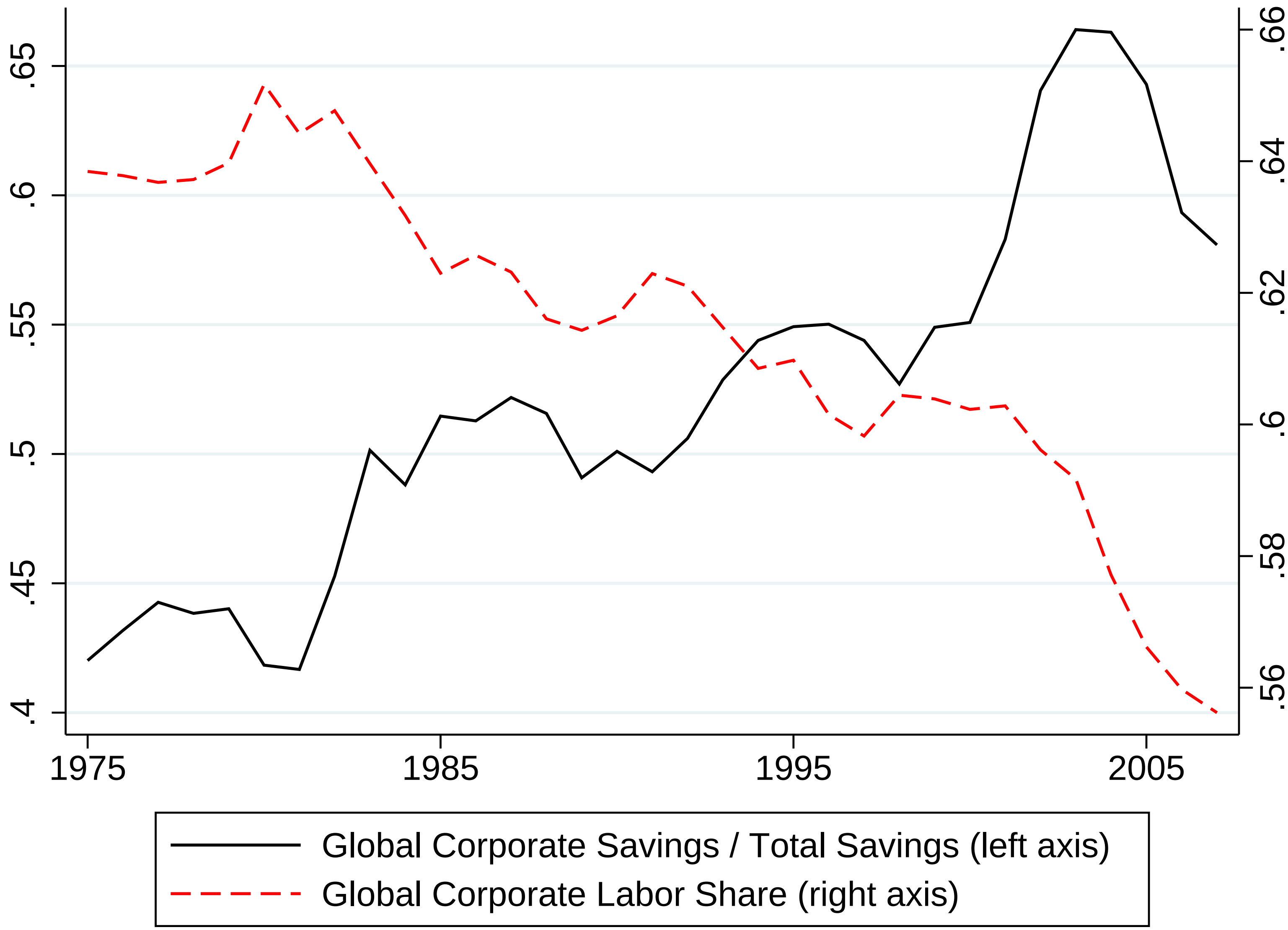



Figure 1: Global Decline in The Labor Share and Increase in Corporate Savings, 1975-2007

Notes: The figure shows the global corporate labor share and the share of global corporate savings in global total savings. We use market exchange rates to aggregate data from all available countries. We have an unbalanced panel. The declines implicit in the figure therefore differ from our baseline estimates of a 5 percentage point decline in labor share and a 20 percentage point increase in the corporate savings share.

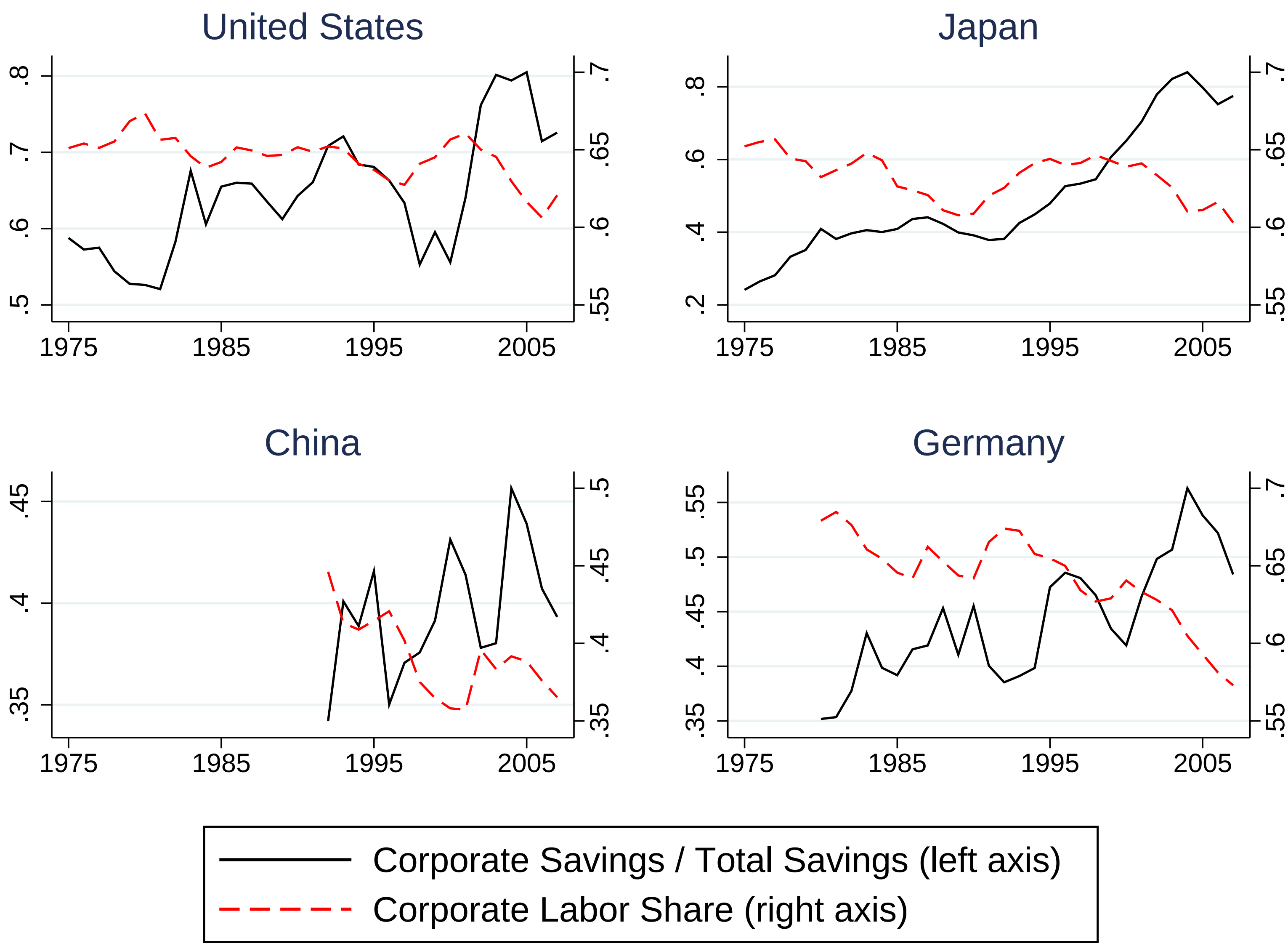



Figure 2: Country-Specific Declines in The Labor Share and Increases in Corporate Savings, 1975-2007

Notes: The figure shows the corporate labor share and corporate savings as a share of total savings for the four largest economies in the world. Japan does not have the data required to calculate a corporate labor share and therefore we plot Japan's overall labor share, scaled by the ratio of corporate to overall labor shares in the rest of the dataset.

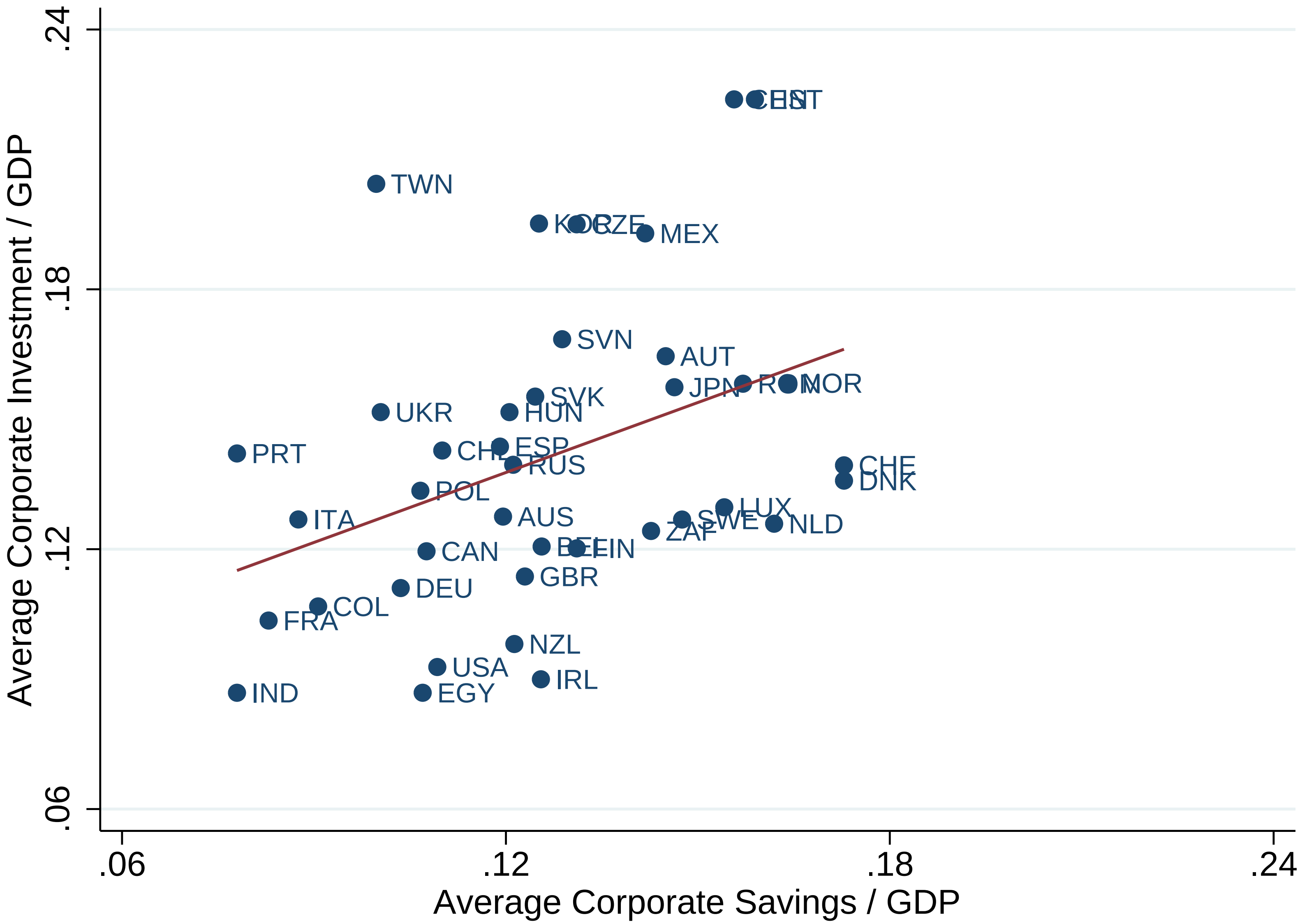



Figure 3: Feldstein-Horioka Puzzle in Global Corporate Sector

Notes: The figure plots the average level of corporate investment as a share of GDP against the average level of corporate savings as a share of GDP for all countries in our data. The largest and smallest values in each dimension of each plot are winsorized to equal the second largest and smallest values. The slope coefficient is 0.54 with a p-value of 0.01. Conditioning on average national investment relative to GDP, reduces the slope to 0.45 with a p-value of 0.00.

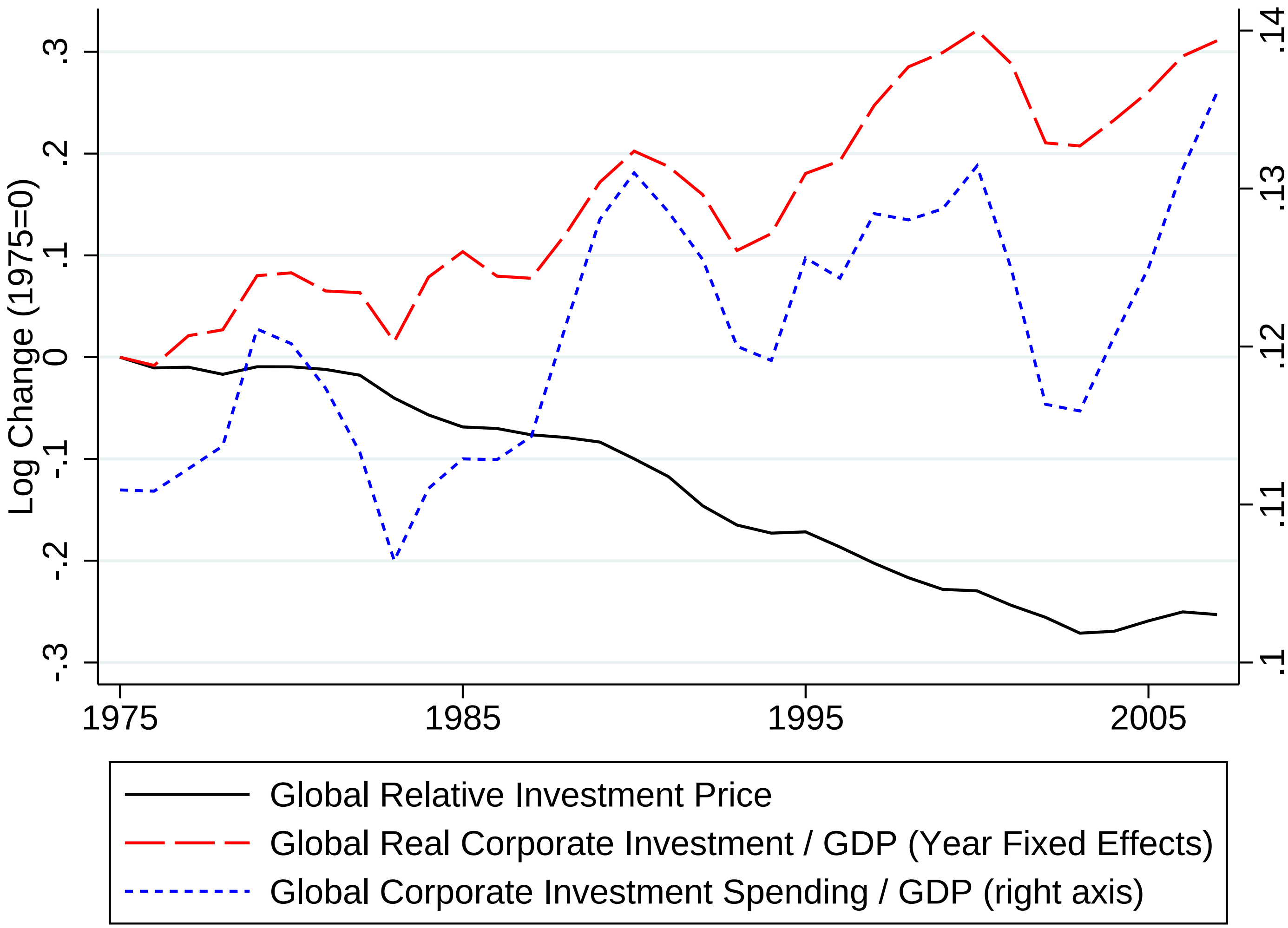



Figure 4: Trend in Global Investment Price and Investment Spending

Notes: The solid line shows the global (GDP-weighted) price of investment goods relative to consumption goods. For each country, the relative price of investment goods is defined as the ratio of the PPP-international price of investment to the PPP-international price of consumption, divided by the equivalent ratio for the United States, and then multiplied by the ratio of the investment deflator to the personal consumption expenditure deflator for the United States taken from the BEA. The long-dashed line shows the year fixed effects from a GDP-weighted regression of the log of corporate investment spending to GDP, deflated by the relative price of investment to GDP, on year fixed effects and country fixed effects (to account for the unbalanced nature of the panel). The short-dashed blue line shows global nominal corporate investment spending as a share of global GDP, where we have used market exchange rates to aggregate data from all available countries.

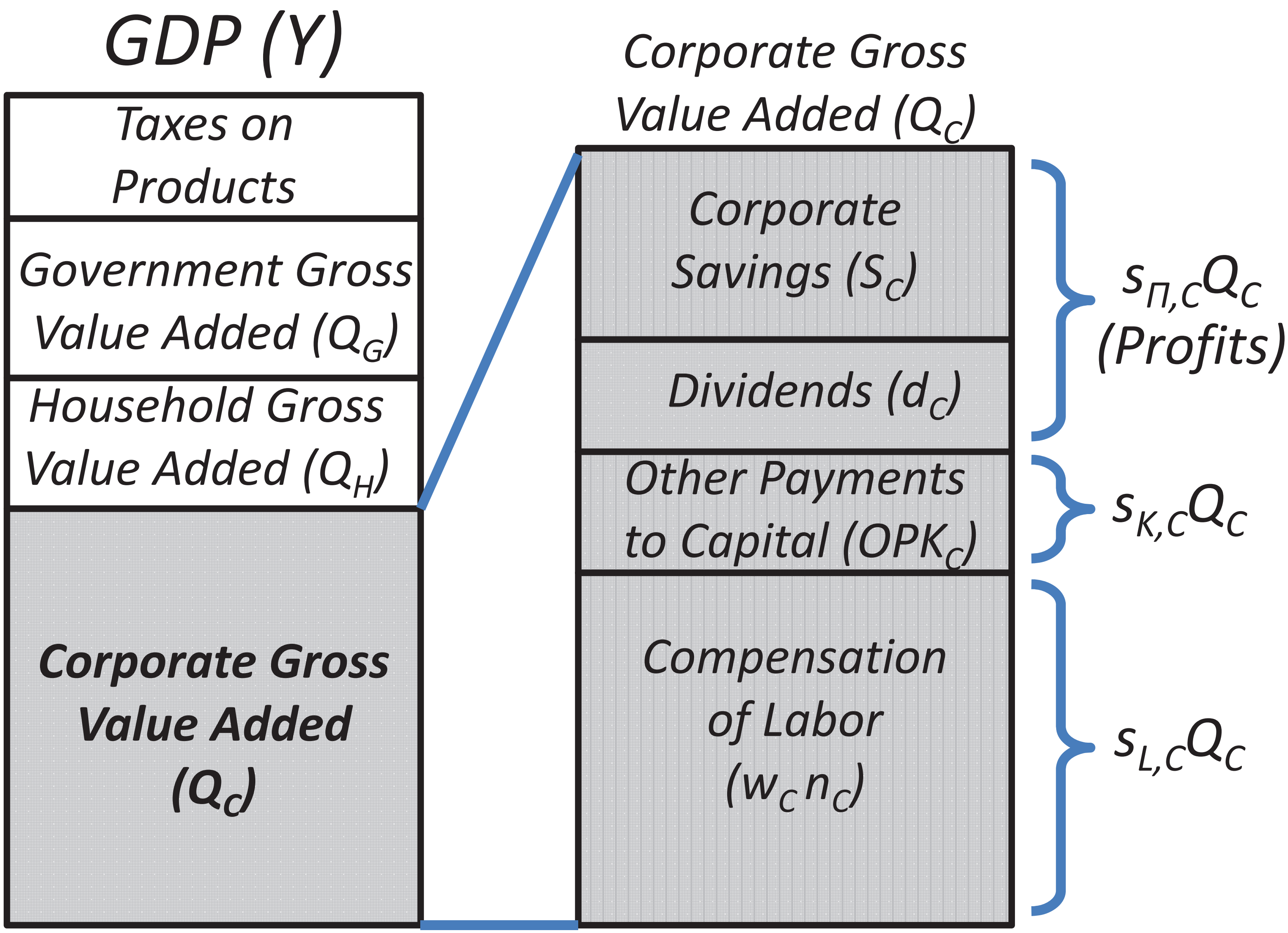



Figure 5: Key National Accounting Concepts

Notes: This schematic shows the breakdown of GDP into four categories in the national accounting data. Corporate gross value added includes three categories taken from the data, plus a fourth category called "Other Payments to Capital" which we define to capture all remaining items. This residual category primarily includes interest payments on borrowing and taxes on production. The sum of corporate savings and dividends is what we call profits.

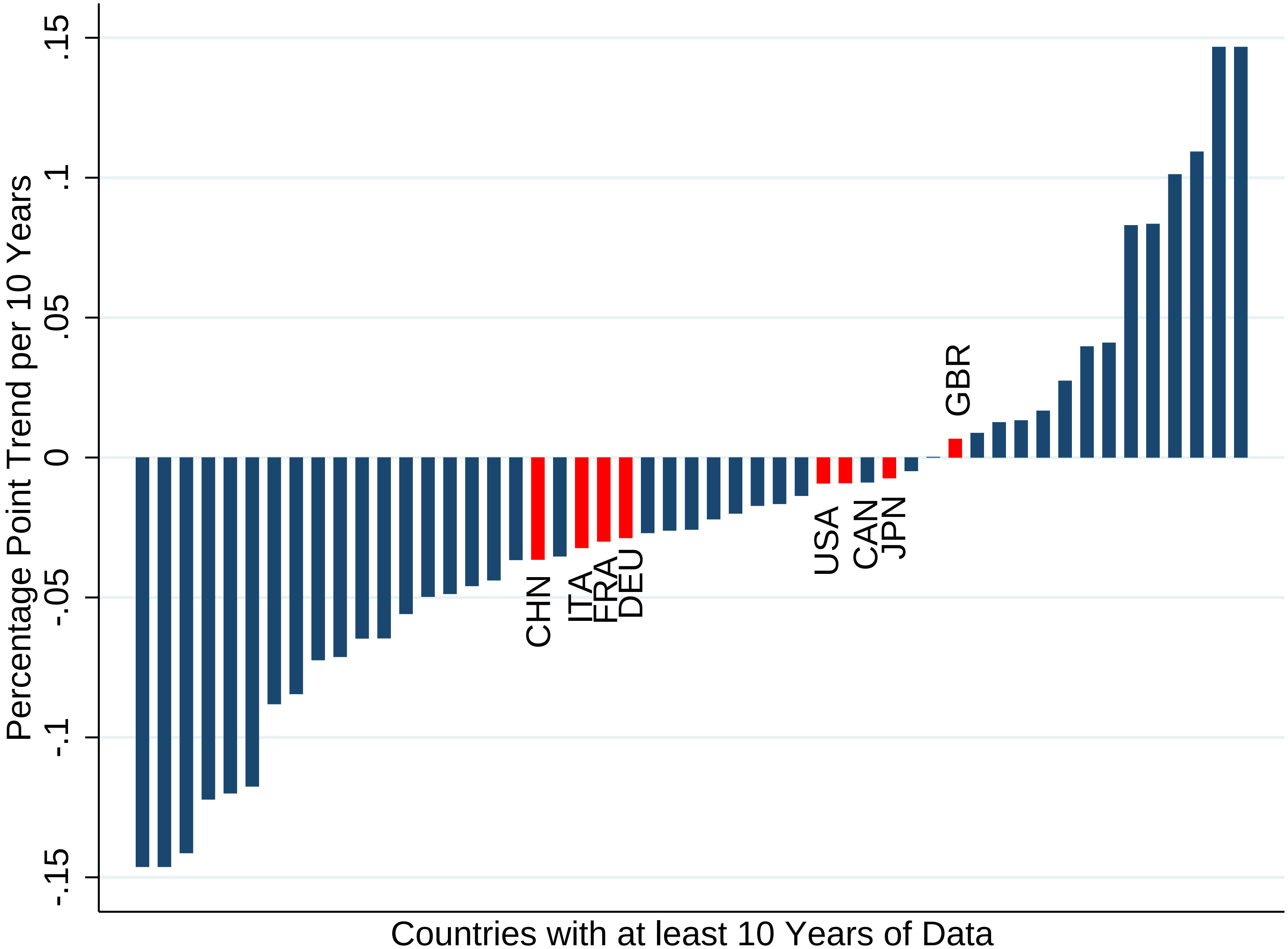



Figure 6: Estimated Trends in Corporate Labor Shares

Notes: The figure shows estimated trends in the corporate labor share for all countries in our dataset with at least 10 years of data (and using the scaled overall labor share if the corporate labor share is unavailable). Trend coefficients are reported in units per 10 years (i.e. a value of -0.05 means a 5 percentage point decline every 10 years). The largest and smallest values are winsorized to equal the second largest and smallest values. The largest 8 economies are highlighted in red.

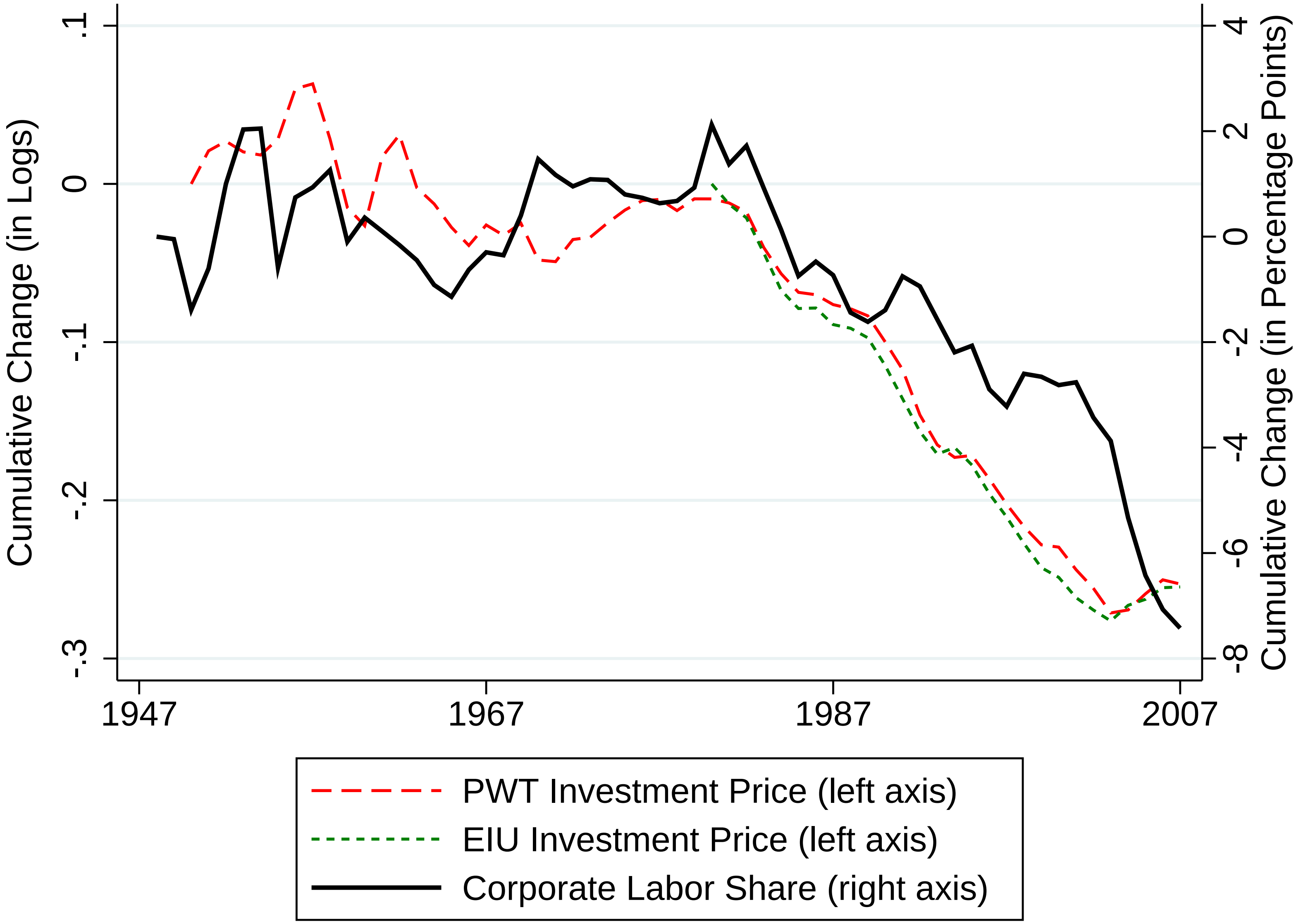



Figure 7: Global Movements in the Corporate Labor Share and Relative Investment Prices, 1947-2007

Notes: The figure shows the GDP-weighted-average relative price of investment from the PWT and the EUI, and the global corporate labor share. All series are normalized to 0 at their earliest point. The investment prices are measured along the left axis in log points while the labor share is measured along the right axis in percentage points.

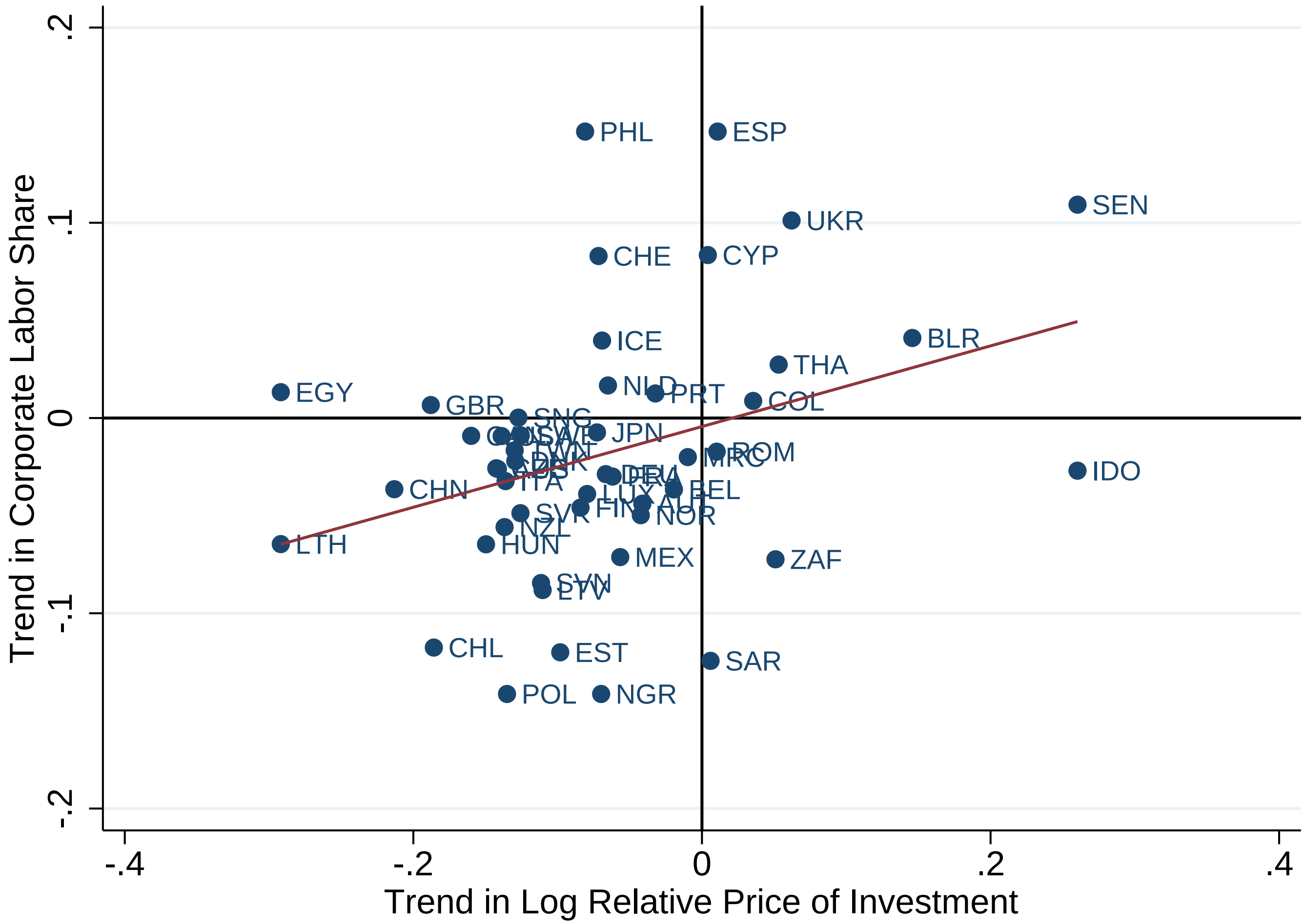



Figure 8: Estimated Trends in Labor Share and the Relative Price of Investment

Notes: The figure shows estimated trends in corporate labor shares against estimated trends in relative investment prices. It includes all countries in our dataset with at least 10 years of data along both dimensions. The largest and smallest values in each dimension of each plot are winsorized to equal the second largest and smallest values. Trend coefficients are reported in units per 10 years (i.e. a value of -0.05 for the corporate labor share means a 5 percentage point decline every 10 years).

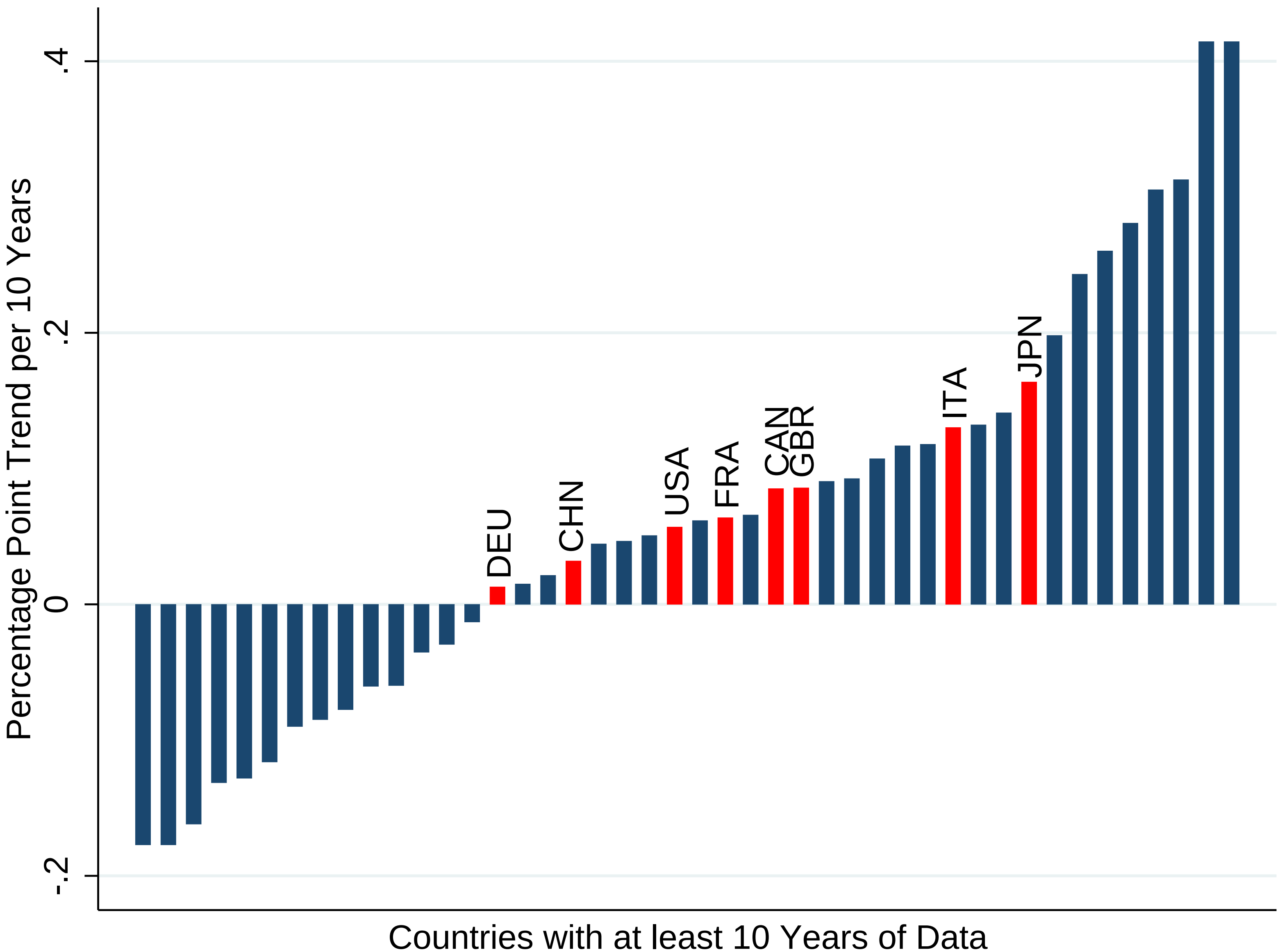



Figure 9: Estimated Trends in Corporate Savings / Total Savings

Notes: The figure shows estimated trends in corporate savings relative to total savings for all countries in our dataset with at least 10 years of data. Trend coefficients are reported in units per 10 years (i.e. a value of -0.05 means a 5 percentage point decline every 10 years). The largest and smallest values are winsorized to equal the second largest and smallest values. The largest 8 economies are highlighted in red.

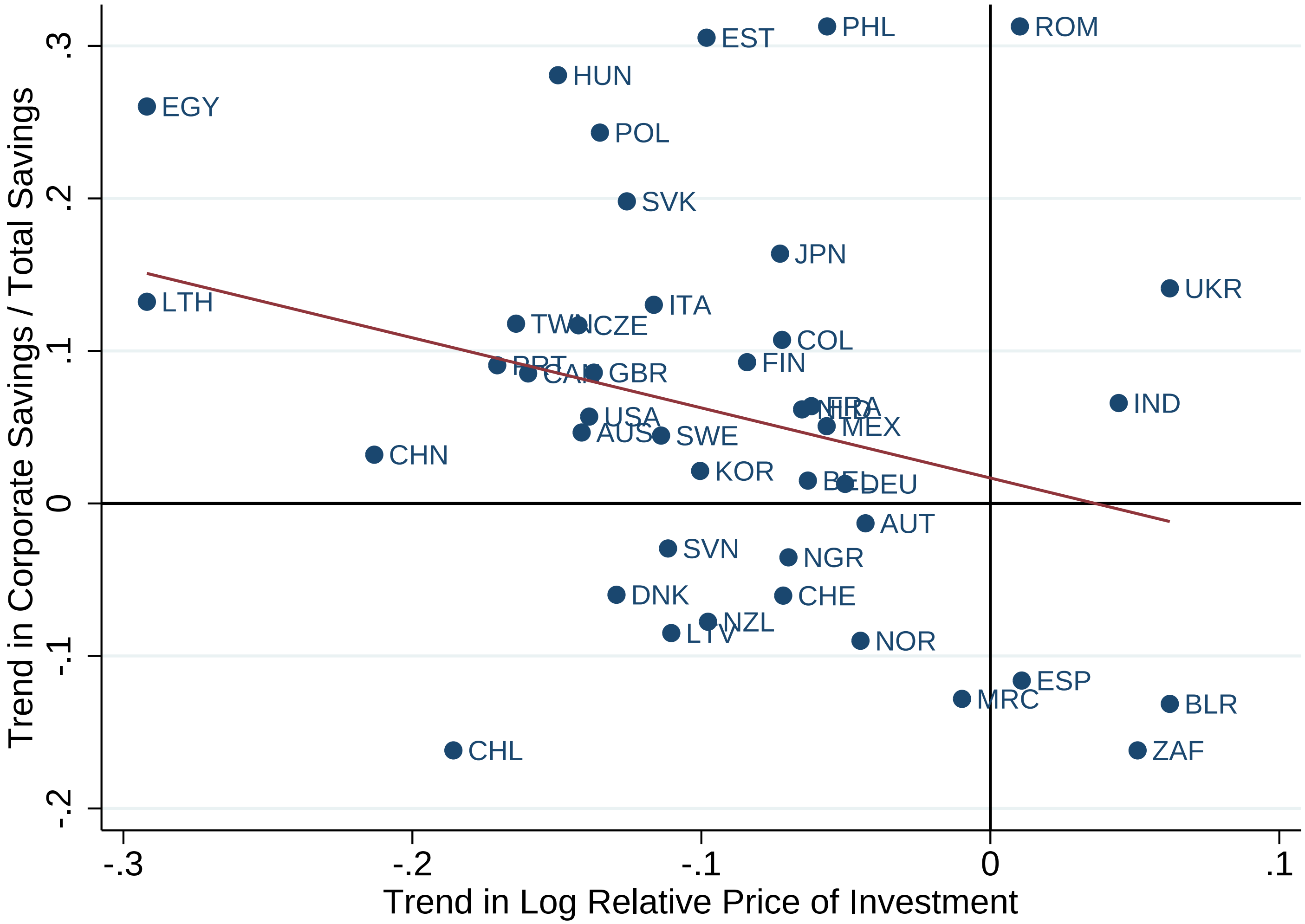



Figure 10: Estimated Trends in Corporate Savings Share and the Relative Price of Investment

Notes: The figure shows estimated trends in corporate savings shares against estimated trends in relative investment prices. It includes all countries in our dataset with at least 10 years of data along both dimensions. The largest and smallest values in each dimension of each plot are winsorized to equal the second largest or smallest values. Trend coefficients are reported in units per 10 years (i.e. a value of -0.05 for the corporate savings share means a 5 percentage point decline every 10 years).

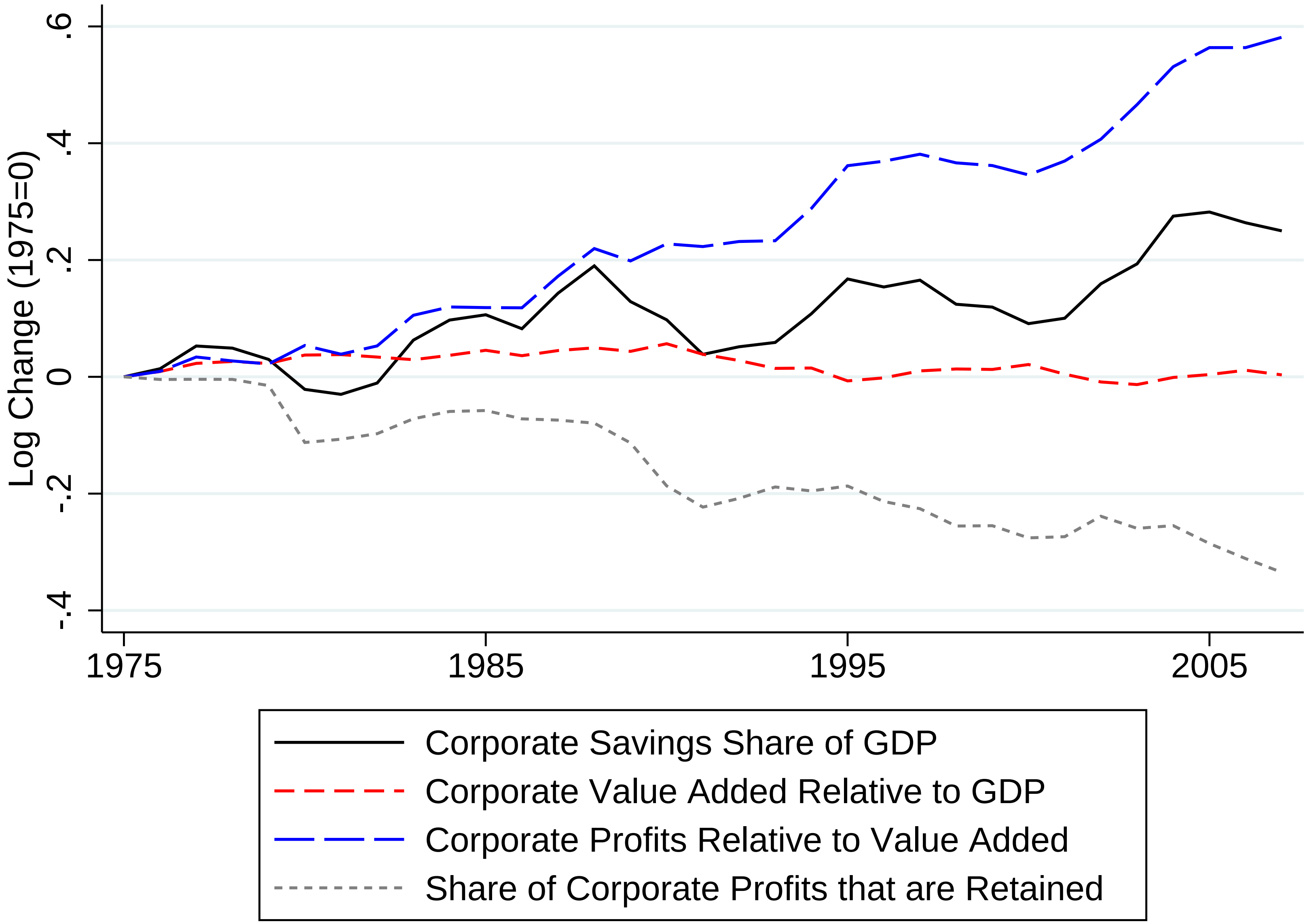



Figure 11: Disaggregation of the Rise in Corporate Savings, 1975-2007

Notes: The figure plots the log of the three terms in the disaggregation in equation (5) and the log of corporate savings as a share of GDP. All variables are measured at the global level. We only include countries with data available on all four terms and we use market exchange rates to aggregate across countries. All series are normalized to 0 in 1975.

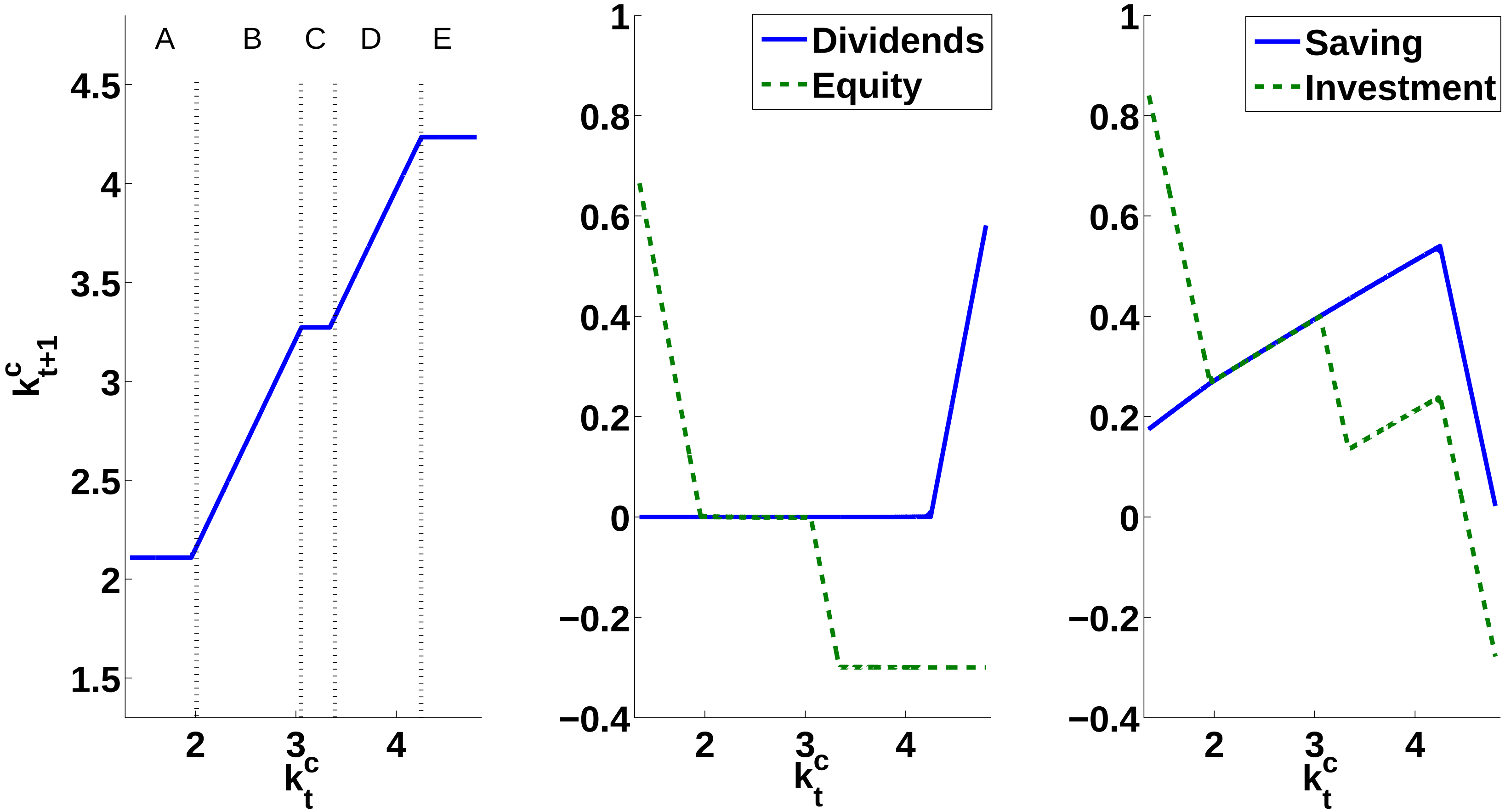



Figure 12: Policy Functions

Notes: The figure shows the policy functions of the corporation in a simplified version of the model without adjustment costs, corporate debt, or taxes.

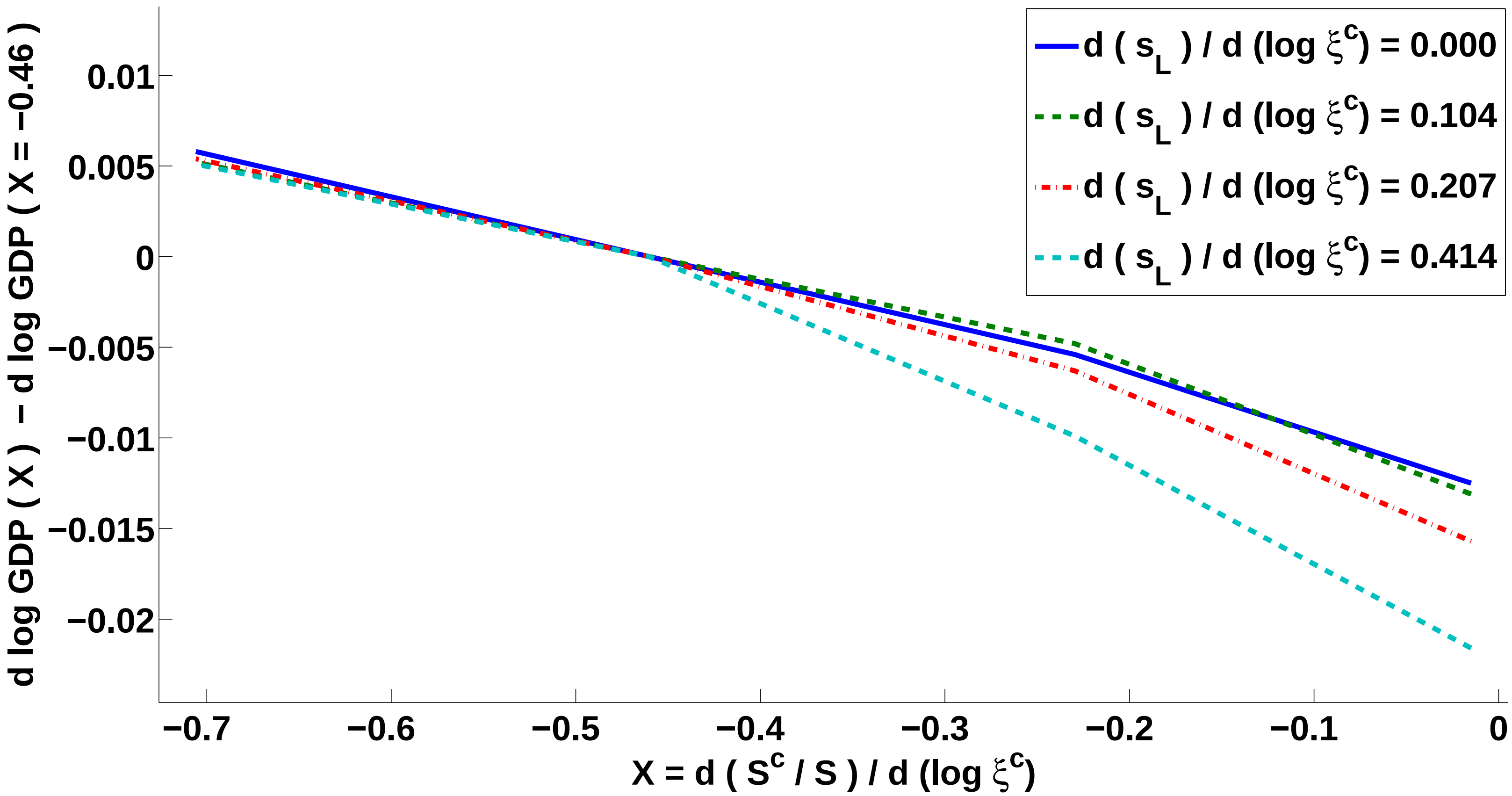
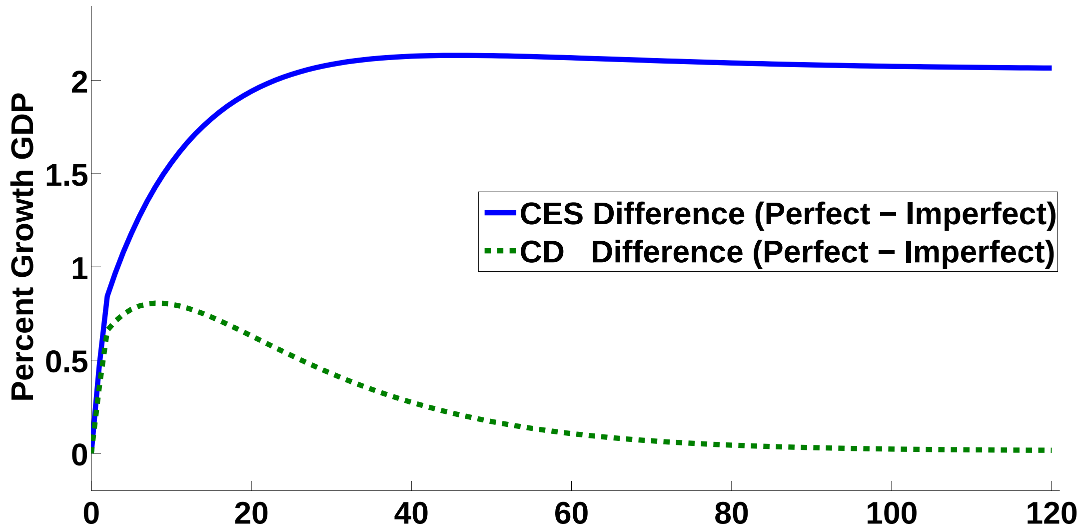
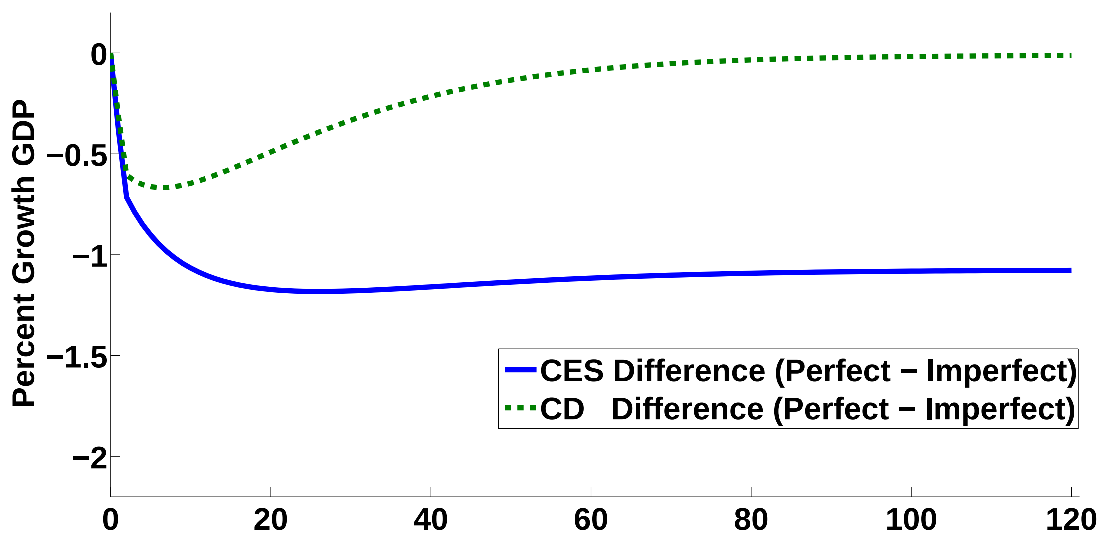



Figure 13: Informativeness of Cross-Sectional Sensitivities to Investment Price Shock

Notes: The x-axis shows the target moment $\mathrm{d}\left(S^c/S\right)/\mathrm{d}\left(\log\,\xi^c\right)$. The y-axis shows the steady state to steady state change in log GDP following the negative price of investment shock for four different values of the target moment $\mathrm{d}\left(s_L\right)/\mathrm{d}\left(\log\,\xi^c\right)$. All steady state to steady state changes in log GDP are normalized to 0 at the value $\mathrm{d}\left(S^c/S\right)/\mathrm{d}\left(\log\,\xi^c\right) = -0.460$.




(a) Positive TFP Shock




(b) Negative TFP Shock

Figure 14: Responses to TFP Shocks

Notes: The figure shows impulse responses to a positive productivity $A$ shock (upper panel) and a negative productivity $A$ shock (lower panel). The paths show the difference in the percent GDP growth between the model with perfect capital markets and the model with imperfect capital markets for the CES model and the Cobb-Douglas model.