The effect of buybacks on capital allocation

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Abstract

This paper studies the macroeconomic effects of a 1982 SEC rule that made share buybacks a viable alternative to dividends for paying out funds to shareholders. I propose a quantitative model of heterogeneous firms with dividend adjustment costs and a manager-shareholder conflict, matched to micro data on US corporations’ cash flow statements. The flexibility of buybacks improves welfare by reducing the misallocation of capital. This is not only because investors can more easily shift resources to more productive firms, but also because stock prices become more responsive to productivity and thus help align incentives of managers and shareholders. This "stock price effect" allows the model to not only account for a decline in investment and increase in productivity, but also the increase in corporate cash holdings over the last decades.

Keywords: Payout policy, Capital reallocation, Investment, Cash holding, Share repurchases, Agency frictions

JEL Codes: D21, E13, E22, E44, G28, G34, G35, G38

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1 Introduction

There is a recent policy debate about the macroeconomic consequences of share buybacks by public firms. On the one hand, there is concern that buybacks may prevent growth by allowing activist investors to seize resources that firms could otherwise invest in productive capital. On the other hand, buybacks make it easier to reallocate funds for other, more productive firms. A large literature in corporate finance has studied payout choice at the firm level. There is strong evidence that firms perceive large costs for decreasing dividends (but not for buybacks) and that shareholders force buybacks to limit free cash flow available to managers inside the firm. What hasn’t been addressed is the aggregate effect of buybacks in general equilibrium. How would the allocation of capital and financial assets change if buybacks were not allowed?

This paper studies the long-term effects of open market buybacks on capital allocation, investment, financial assets and welfare. To do that, I focus on two features of firm governance structure. First, firms view share buybacks as a more flexible form of payout, while dividends are difficult to cut. Second, there is a shareholder-manager conflict because managers have an empire-building motive and thus tend to overinvest. I develop a new quantitative general equilibrium model of heterogeneous firms that captures these agency and payout frictions. When the model is matched to aggregate data moments on public firms, it successfully replicates micro-level payout dynamics. I use counterfactuals to estimate the effect of a 1982 regulatory rule that made it substantially easier for US firms to buy back their shares. In the long run, this buyback rule reduced capital misallocation, accounting for almost half of the observed increase in aggregate profitability in the data. This is because buybacks allow shareholders to shift resources from unproductive to productive firms more easily. Furthermore, buybacks increase the sensitivity of stock prices to profits. Since managers are compensated in stock, their incentives become more aligned with the shareholders’ and the model can also account for part of the decline in corporate investment and almost all of the increase in corporate financial asset holdings.

Since the classic study of Lintner (1956), which finds that public firms strongly believe that markets penalize dividend volatility, there has been an extensive literature studying the excessive persistence of dividends. After buybacks became a viable alternative to pay shareholders, it became clear that firms perceive share buybacks as a more flexible form of payout.\footnote{The November 1982 SEC Rule 10b-18 provided specific guidelines that, if followed, would allow firms to buy back shares in the open market without facing legal threats for price manipulation, effectively removing an important barrier for open market buyback activity. John Shad, the SEC Chairman at the time, said that without the change, companies were effectively inhibited from making big open-market buys.}

\footnote{See Fama and French (2001) and Grullon, Michaely, and Swaminathan (2002).}
For example, surveys of firm executives reveal stark differences in the perceived difference in flexibility between dividends and payouts (Brav, Graham, Harvey, and Michaely, 2005). These differences are cited in these surveys as a key determinants of firms’ payout decisions. The model captures these perceptions with payout frictions.

Buybacks and dividend dynamics are indeed very different both at the aggregate level as well as the individual firm level. I show that the aggregate increase in buybacks after 1982 did not trigger a noticeable change in dividends. This evidence suggests that buybacks and dividends are not highly substitutable, and that the increase in buybacks has instead impacted other decisions in the corporate sector. I then use micro data on cash flow statements to show three stylized facts about payout dynamics that are consistent with the survey evidence. First, despite their lack of flexibility, dividends are not disappearing due to buybacks. Dividends are still broadly used. In fact, the share of public firms that initiates dividends every year is higher than thirty years ago. Second, the dividend (buyback) initiation of a firm does not depend on whether the firm has used buybacks (dividends) the previous year. This fact is hard to reconcile with models of different permanent types of firms that specialize in one form of payout. Rather, it is consistent with a model where firms decide every period how to pay out based on the shocks they receive.

The third stylized fact is that individual dividend payments are highly persistent, while buybacks are more transitory. To show that, I characterize the flexibility of payouts by running a nonparametric regression of future payout changes on past payout changes by each firm. For instance, if a form of payout followed a random walk, changes would be unpredictable and the conditional expectation of payout changes would always be zero. This is approximately true for dividends. In contrast, positive buyback changes strongly predict negative buyback changes in the next period, a pattern consistent with a transitory process where we expect any positive value to revert quickly to its mean.

The model features a continuum of firms which face equity issuance, agency, and payout frictions. The payout frictions are designed to capture the survey evidence and stylized facts. First, dividends are subject to downward convex adjustment costs, which makes them hard to decrease. Second, buybacks are subject to linear costs, which capture the legal compliance costs that are required by the buyback rule guidelines. These costs make buybacks more flexible but not obviously cheaper than dividends. Firms have decreasing returns in capital and labor and receive transitory and persistent idiosyncratic productivity shocks. Firms have shareholders in charge of equity issuance and equity payout decisions, while managers

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3Firms’ views provide little support that differences in demand, such as differential institutional preference, have a significant impact in payout decisions.
are in charge of investment and cash holding decisions. Managers are more informed than shareholders and receive part of their compensation in the form of stocks which makes them care about the profitability of the firms. However, managers also have a preference for "empire building" so that they care about the size of the capital stock in the firm regardless of profitability. Firms are owned by a representative household who consumes the goods they produce and supplies labor.

For firms that receive positive transitory shocks, buybacks are effective at controlling managers’ biases. When a firm has low expected productivity, shareholders would like to take excess money out of the firm to prevent misuse by the manager. Due to the adjustment cost, dividends are an expensive mechanism to pay out transitory cash flows. Firms do not like to increase dividends if it seems likely they will have to reduce them later. When linear costs of buybacks are low, two channels directly affect firm investment. First, there is a funding channel; shareholders can more cheaply get resources out of the firm, reducing manager funding. Second, there is a stock price channel; any extra dollar in the firm is easier to get out of the firm with buybacks if needed. This increases the marginal value of an extra dollar to shareholders. This makes the stock price more responsive to profits. As a consequence, stock-based compensation realigns manager incentives to place more weight on profits relative to capital.

An important result from the model is the complementarity between two commonly studied mechanisms of shareholders control over managers: payouts and stock-based compensation. The ability to force payouts affects managers’ budget constraints and the stock-based compensation affects managers’ incentives. When shareholders can enforce payouts more flexibly—in this case, by the addition of buybacks— the stock price comoves more with profits. Thus, not only does their control over managers’ budget improves (funding channel) but also stock-based compensation becomes more effective (stock price channel).

To study the quantitative importance of these channels at the macroeconomic level, I quantify the model in stationary equilibrium using cash flow statements and balance sheet data on public firms from 2004 to 2017 to estimate the friction parameters. The quantification strategy is performed in three steps. First, I estimate the production function parameters and productivity processes using the method of moments on production data in a dynamic panel. Second, I pick the preference parameters and tax rates from the literature. Third, I estimate five friction parameters using seven aggregate moments on financial assets, operating profits, dividend growth, equity issuance, and buybacks. The model captures well the overidentified moments in the data.

Moreover, even though the payout frictions are only disciplined by two parameters matched
to aggregate payout moments, the model accurately replicates the micro-level payout dynamics. To show that, I simulate a series of transitory and persistent idiosyncratic shocks from the model and perform nonparametric regressions of future payout changes on past payout changes. The model does a good job at replicating the nonparametric relation between the changes in payouts over time in the data. In other words, the conditional expectation function of buyback changes in the model fits the conditional expectation function of buyback changes in the data. Similarly, the conditional expectation function of dividend changes in the model fits the corresponding function in the data in the empirically relevant range.

To understand the effect of the buyback rule, I consider a counterfactual economy in which firms do not have the option to buy back shares. In the absence of buybacks, aggregate investment is higher and cash holdings are lower. However, capital misallocation increases. A large amount of resources are held by unproductive firms and managers invest them in capital to build their empires rather than hold cash.\footnote{This is consistent with the prevalence of conglomerates and excess capacity of corporations in the 1970s. Holmstrom and Kaplan (2001) analyze the evidence that suggests this behavior was reduced by the increased influence of markets on corporate decision-making.} Comparing the model predictions with the observed trends in the National Accounts, I find that the buyback rule can account for 48% of the observed decline in investment as a share of profits, 47% of the increase in operating profits as a share of capital and 88% of the observed increase in financial asset holding of the corporate sector.

An implication of this model is that a reduction in the agency conflict increases the amount of cash relative to capital at the aggregate level. The main ingredient driving this relation is that managers are not in charge of payout policy. Their role in the firm is to choose between investing funds on firm idiosyncratic productivity or saving them in a risk-free bond. This captures the fact that the board of directors, which represents shareholders, needs to approve payout and equity decisions every quarter. In contrast, the timing of investment takes place at higher frequencies. Thus, it is harder to monitor and it’s delegated to informed managers. As a consequence, when more aligned managers receive negative private signals they are more willing to wait and hold cash rather than invest in capital to build their empire.

I then compare the economy without buybacks to a constrained optimum where there are no agency frictions, but financial frictions are still present. In this constrained optimum, financial frictions still generate misallocation of resources across firms but the resources allocated to a given firm are put to the best use inside that firm. Compared to this constrained optimum, the economy without buybacks overinvests and has higher capital misallocation. The aggregate level of capital is 3.4% higher and profitability 2% lower than the constrained
optimum. In contrast, the economy with buybacks underinvests relative to the constrained optimum but capital allocation is very similar. The aggregate level of capital is 7% lower than the constrained optimum but profitability is only 0.3% lower. The reason that the corporate sector underinvests after the buyback rule is because the increased ability of shareholders to shift resources across firms reduces managerial discretion. This prevents manages from building inefficient empires, but also prevents them to use their informational advantage to take the highest investment opportunities.

I estimate that the difference in long-term welfare implied by the buyback rule is positive and sizable. The representative household receives the full benefits of the increase in firms profits. Further, the household can supply less labor due to increases in allocative efficiency. The size of the welfare difference depends on the exact nature of the equity, dividend and buyback costs that I assume. If they represent legal fees or other transfers, they should be reimbursed to the household in the model estimation. If they represent wasteful spending, they should not. I calculate both extreme cases and find that long-term welfare differences are always positive, ranging from 2.5% to 6.6% in consumption equivalent units.

The empire-building preferences of the managers are increasing in capital and concave. These preferences represent private benefits that are not received by shareholders. In general, it induces managers to act as if capital were more productive than it actually is. Thus, it could also represent a degree of miscalibration (Ben-David, Graham, and Harvey, 2013), overconfidence (Malmendier and Tate, 2005, 2008) or manager compensation perks that correlate with firm size (Gabaix and Landier, 2008). In consequence, although I refer to the motive as a preference parameter, it should be interpreted more broadly as affecting the manager decisions. The function is concave to represent diminishing returns to private benefits. Similarly, the concavity could also indicate increasing marginal costs of manager empire building as monitoring efficiency increases with firm size.

This model also has implications for the analysis of payout tax incidence on investment and welfare. In traditional models of firm investment without agency frictions, the incidence of payout taxes depends on their effect on the marginal cost of financing relative to their effect on the marginal return on investment. In this model, financing and investment decisions are taken on different margins. Thus, the impact of taxes on investment depends on two trade-offs: the shareholder’s marginal cost of financing relative to the marginal benefit of funding, and the manager’s marginal benefit of capital relative to cash. For firms where managers are constrained, investment decreases one-to-one with funding received. Thus, tax incidence on investment depends on the marginal cost of financing, much like in traditional models. For firms with unconstrained managers, dividend taxes may lower funding but they only have...
a second-order impact on capital investment. Further, this impact is ambiguous in sign due to the stock price channel. I find that an increase in dividend taxes by 5% would decrease investment by 1.7% but would increase profitability by 1.4% and consumption equivalent welfare by 0.36% by reallocating capital to more productive firms.

Related literature

This paper contributes to several strands of literature. There is a large empirical literature documenting the excessive smoothness of dividends relative to earnings. Brav, Graham, Harvey, and Michaely (2005) use survey evidence to document that firms perceive buybacks as more flexible than dividends. Jagannathan, Stephens, and Weisbach (2000) find that firms prefer to use buybacks rather than dividends when their non-operating income as a share of total income is larger and when earnings volatility is higher. Guay (2000) finds larger reversions in operating cash flows after firms increase dividends than after paying buybacks. DeAngelo, DeAngelo, and Skinner (2004) and Julio and Ikenberry (2004) find that despite the differences in perceived flexibility, the use of dividends has not declined in dollar value and remains a strong component of aggregate payouts. I contribute to this evidence by establishing new time-series properties of the payout processes directly.

The paper is related to literature studying the determinants and effects of share buybacks at the firm level. An argument that is widely used in the political discussion connects buybacks to short-termism by shareholders. The idea is that buybacks have a negative long-term impact on firm value. However, most existing evidence (Peyer and Vermaelen, 2009; Yook, 2010; Autore, Clarke, and Liu, 2019) shows positive long-run effects of buybacks on firm value. Two other hypotheses are consistent with a value-adding function of buybacks. Buybacks can be used as a signaling device in the presence of asymmetric information (Miller and Rock, 1985), or as a disciplining device in the presence of agency frictions (Easterbrook, 1984; Jensen, 1986). In my model, buybacks fulfill the latter function by two different channels that have distinct and relevant implications in a dynamic equilibrium. Consistent with the disciplining hypothesis, Grullon and Michaely (2004) find that the market reaction after buyback announcements is more positive among firms more likely to overinvest. La Porta, Lopez-de Silanes, Schleifer, and Vishny (2000) find international evidence that companies buy back more shares when

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5 See Allen and Michaely (2003), Ben-David (2010) and Leary and Michaely (2011) for an evaluation of different explanations.

6 A group of 21 Senators published in June 2019 a letter to the SEC Chairman concerned that "...short-term interests are too often driving stock buybacks..." and pushed for stricter buyback regulations in order to "...facilitate job growth and long-term investment in their firms." Between 2018 and 2019, three bills (S.2391, S.2514, S.915) have been introduced in the US Senate to restrict the protections of Rule 10b-18 for open market buybacks.

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investors have stronger legal governance mechanisms in place.\footnote{See Farre-Mensa, Michaely, and Schmalz (2014) for a comprehensive survey of recent evidence on the disciplining function of buybacks.}

A large literature studies the increase in corporate holdings of financial assets.\footnote{Bolton, Chen, and Wang (2011), Falato, Kadyrzhanova, and Sim (2013), Boileau and Moyen (2016), Chen, Karabarounis, and Neiman (2017), Armenter and Hnatkovska (2017), Zhao (2019).} This paper contributes to this literature by proposing a complementary explanation: the rise of buybacks increases the sensitivity of stock values to profits and thereby provided better incentives for managers, which reduced (over)investment and increased cash holdings. This mechanism has strong implications linking buybacks, agency frictions and cash holdings. A less aligned manager will tend to hold less cash, and shareholders will choose higher payouts to reduce funds within the firm. This is consistent with empirical evidence that documents a negative relationship between agency problems and cash holdings. Harford, Mansi, and Maxwell (2008) find cross-sectional evidence that firms with higher agency problems have smaller cash reserves and that such firms prefer to buy back shares, instead of increasing dividends. Consistent with the stock price channel in the model, Dittmar and Mahrt-Smith (2007) find that the sensitivity of equity returns to cash is lower for firms with high agency problems. Bates, Kahle, and Stulz (2009) find that firms with higher Tobin’s q increased cash holdings the most in the last few decades.

The model is also related to recent literature on corporate taxation. Gourio and Miao (2010) stress the importance of dynamic considerations and firm heterogeneity. Tax incidence in a dynamic heterogeneous model depends on the distribution of firms across their marginal source of financing. In this paper, the distribution of firms is important across two dimensions: the marginal source of financing and the degree of constraint of the manager. Similar to Chetty and Saez (2010)’s model of agency costs, the model predicts that investment responses to tax reductions are smaller when managers put more weight on profits,\footnote{This implication has been supported by cross-sectional evidence from Becker, Jacob, and Jacob (2013) and Moon (2019).} and that it may even have negative sign. In Chetty and Saez’s model, the manager makes both payout and financing decisions and shareholders decide the weight that the manager place on profits. Taxes affect manager’s investment and financing decisions because they affect the choice of the weight made by shareholders. In my model, the manager’s weight on profits is affected endogenously by price movements, not by shareholders. Further, investment is also constrained by shareholder’s financing decisions that control internal funds. My model in equilibrium has allocative implications of dividend taxes consistent with evidence from Alstadsæter, Jacob, and Michaely (2017) and Becker, Jacob, and Jacob (2013), who found that the 2003 dividend tax
tax reduction reallocated investment from resource-rich firms to equity-issuing firms.

This paper is related to literature that studies firm heterogeneity and the sources of capital misallocation (Hopenhayn, 2014). In my model the source of misallocation is the interaction of payout frictions with agency frictions inside the firm. There is another set of models of corporate dynamic investment that study the interactions between real and financial decisions (Strebulaev and Whited, 2012). These models focus on financial frictions that prevent firms from getting money into the firm. My model focuses on the frictions to get money out of the firm.\footnote{Jermann and Quadrini (2012) also feature adjustment costs to dividends. In their model the adjustment cost is symmetric and depends on an average fixed level of dividends, instead of previous dividend choices. Buybacks are strictly preferred but they are capped by a hard constraint.} Eisfeldt and Muir (2016) estimate a dynamic model of heterogeneous firms financing and cash holdings decisions, inferring financial costs from observed cash holding trends. In my model the financing and cash decisions are decoupled due to the firm governance structure. Therefore, I partially infer the manager agency frictions from cash holding data and the equity issuance frictions from traditional moments of equity issuances and capital dispersion.

Finally, this paper contributes to a literature that has tried to explain the observed decline in investment rates\footnote{Furman (2015), Lee, Shin, and Stulz (2016), Gutiérrez and Philippon (2017, 2018), Farhi and Gourio (2019), Zhao (2019).} Gutiérrez and Philippon (2018) and Lee, Shin, and Stulz (2016) have pointed out the observed negative relationship between share buybacks and investment. They have proposed that increases in concentration or decreases in agency costs could be the underlying cause of both phenomena. I complement these explanations with a new channel: the interaction of increasing payout flexibility and agency frictions. My model endogenously generates an increase in firm concentration, and a decrease in agency costs. The increase in payout flexibility can speak in general equilibrium to both the decline in investment, the increase in capital profitability and the increase in financial assets.

Layout

The paper is structured as follows. Section 2 discusses the datasets and stylized facts about the persistence of dividends and their coexistence with buybacks in modern public firms. Section 3 lays out a dynamic general equilibrium model with agency, payout and equity frictions. Section 4 discusses the main transmission channels at the firm level. Section 5 presents the quantification strategy to match the model to the current economy. Section 6 presents different results about the fit of the estimated model and the reallocation and aggregate effects implied by the counterfactual exercise. Section 7 concludes.
Figure 1: Shareholder payouts as a share of profits

Notes: The figure shows the share of annual profits distributed to shareholders by the US nonfinancial corporate sector. Data is obtained from the National Income and Product Accounts. Profits are calculated as Income from operations plus property income received minus non-dividend property income paid. Net buybacks are calculated as the negative of net incurrence of corporate equity liabilities.

2 Corporate trends and payout dynamics

This section presents evidence about corporate trends and firm level data on in the United States. On aggregate, buybacks as a share of profits have increased since the early 1980s, while dividends have stayed roughly constant. Investment as a share of profits have declined. Financial asset holdings as a share of capital have increased. The firm level evidence illustrates two stylized facts of firm payouts. First, dividends are more persistent than buybacks. Second, dividends are not being replaced by buybacks. Dividends are widely used and are still initiated at relatively stable rates.

The quantitative model in Section 3 will incorporate these features, modeling different frictions in payout mechanisms and two different types of idiosyncratic productivity shocks. In Section 6 non-parametric regressions of firm-level payout dynamics to compare the predictions of the model.
2.1 Evidence from aggregate national accounts

I construct aggregate yearly data from the nonfinancial corporate business sector of the United States using the Current Accounts and the Capital Accounts of the National Income and Product Accounts (NIPA). Net share buybacks are reported by the Federal Reserve Board’s Flow of Funds Accounts (FFA). Corporate profits include operating profits (income from operations) and financial profits (property income received/paid from holding financial assets/liabilities). Corporate investment is defined as gross capital formation. Financial Assets are defined as long term financial assets plus net short-term financial assets.\textsuperscript{12}

Figure 1 shows the amount of dividend payments and net share buybacks that are distributed by the US corporate sector to shareholders as a fraction of profits.\textsuperscript{13} As Figure 1 shows, net share buybacks distributed by the corporate sector were mostly negative from 1960 to 1982, averaging -2.5% of profits. This means that money raised through equity issuances was greater than gross share buybacks, which amounted to less than 4.5% of corporate profits prior to 1982. Open market stock buybacks were rare due to the regulatory ambiguity and associated litigation risk linked to price manipulation. In 1982, SEC Rule 10b-18 provided a safe harbor for public firms willing to participate in open market stock buybacks as long as they satisfy certain conditions regarding timing, price, and transparency of the operation. After 1982, share buybacks became significantly positive, taking up in net value a large fraction of total profits in the period of 1983 to 2017.

Unlike buybacks, aggregate dividend payments are remarkably stable, showing much smaller fluctuations. Furthermore, the increase of buybacks after rule 10b-18 did not seem to trigger a decline in dividends as a share of profits. This evidence strongly suggests that dividends and buybacks are not seen as highly substitutable payout mechanisms by firms. Instead, the presence of buybacks must have changed corporate behavior in some other way.

Figure 2 shows the long-term behavior of corporate ratios in the last four decades. The amount of corporate investment as a share of total profits has declined from 81.1% in 1970-1982 to a 65.1% in 2010-2017.\textsuperscript{14} This ratio measures how much of the profits are reinvested in operations whose returns are related to firm productivity. Second, the size of corporate assets invested in financial instruments has increased from a 4.2% in 1970-1982 to a 14.6% in 2010-2017, an increase in 10.4 pp. This ratio measures the relative amount of resources that firms

\textsuperscript{12}All variable definitions are shown in detail in the Appendix.
\textsuperscript{13}Net share buybacks reflect the value of funds distributed through the retirement of equity net of funds raised through selling equity.
\textsuperscript{14}The observed decline in investment share has not been driven by a significant change in depreciation rates. The Appendix shows that the decline of the investment share net of depreciation has been quantitatively similar.
choose to invest in assets whose returns are independent of firm idiosyncratic productivity. Finally, operating profits per unit of capital have increased from 11.1% to 14.4%, an increase of 3.3 pp. This ratio indicates the profitability of capital. It will be low if capital is allocated on firms with low idiosyncratic productivity.

### 2.2 Evidence from public firm individual data

This subsection shows two stylized facts about payout dynamics. I use yearly public firm individual data from Compustat. The cash flow statements of each firm contain information about dividend, buyback and equity issuances for that fiscal year. Profits are defined as operating cash flows, which include income from operations, interests paid due to financial liabilities, and any dividends or interest received from financial assets. The exact definition used in Compustat to construct each variable is shown in the Appendix.
Figure 3: Predictability of dividend and buyback changes

Notes: The figures show the distribution of nonzero payout changes (top) and the nonparametric regression fit of the future payout changes on current payout changes normalized over current sales on panel data of public firms from 2004 to 2017 (bottom). 95% confidence intervals with bootstrap errors in light-colored blue. Data is taken from income and cash flow statements of all firms with at least ten consecutive years in Compustat. Dividends are defined as Cash dividends ($dv$) minus preferred dividends ($dvp$). Buybacks are defined as Purchase of Common and Preferred Stock ($prstkc$). Dividend and buyback changes are trimmed at 5% and 95%.
Dividends are very persistent relative to buybacks

Firm executives consistently answered that buybacks are more flexible than dividends. Brav, Graham, Harvey, and Michaely (2005) surveyed financial executives from large public and private US companies. An important conclusion derived from these responses is that firms are reluctant to cut dividends, and the level of dividend payment is taken as given. Further, 65% would rather raise costly external funds before reducing dividends, compare to only 10% of the executives who answer the same for buybacks. Flexibility of buybacks allows managers to alter payout in response to the availability for good investment opportunities, or simply to return capital to investors at the appropriate time.

Firms face large costs to decrease dividends and they see buybacks as flexible. To understand the importance and shape of these barriers, I estimate how persistent are dividends relative to buybacks at different points in the distribution of payout changes. For instance, taking the extreme case, if dividends had permanent persistence and followed a random walk, dividend changes would be unpredictable from past changes. For each firm-year observation in the Compustat sample on the relevant period 2005-2017, I obtain current dividend change and compare it to dividend change next year, normalized by sales in the current year. Figure 3 shows a non-parametric regression of future dividend changes on current dividend changes after removing 10 percent of the observations on the tails. Expected dividend changes almost run through a flat line. This means that dividends are very persistent processes. In the top we see a histogram of the normalized dividend changes used in the regression.

The non-parametric regression on buybacks, on the other hand, shows that changes in buybacks are predictable. The buyback pattern is consistent with transitory processes, where we expect any positive shock to revert quickly to its mean. For any positive change, we expect a similar negative change in the following period. The persistence profile is humped shaped because buybacks are a nonnegative process. If one wants to capture buyback and dividend frictions, tracking these two patterns is important.

On the top, we can notice that changes in buybacks are more volatile than changes in dividends. The aggregate evidence showed us that buybacks are more volatile than dividends. These histograms show that at firm-level, buyback changes are also more volatile than dividend changes.

Dividends in the U.S. are not disappearing

The individual firm evidence in Figure 4 shows us that the aggregate dividend stability observed after the buyback rule is not a phenomenon driven exclusively by old or large firms.
The first measure show the percentage of public firms paying dividends. As noted by Fama and French (2001), the percentage of public firms paying dividends did go through a decline from 1980-2000. However, this decline started before the buyback rule change. This decline was largely explained by both an increase in the total number of publicly listed firms and an exit of dividend payer firms, as DeAngelo, DeAngelo, and Skinner (2004) found. Moreover, the tendency reversed in the first half of the 2000 decade and is at a similar level to 1982. While the number of publicly listed firms has declined, the number of firms paying dividends has remained almost constant increasing the percentage of firms paying dividends. This means that dividends are not becoming an exclusive form of payment just for a handful of large firms but remain a feasible payment method across the public sector.

Another plausible hypothesis is that current dividend payments are just a legacy behavior from old firms. According to this hypothesis, dividends are payed mostly by firms who started paying dividends before the buyback rule change. Firms that want to initiate payouts in the current regulatory environment, would prefer to do so via buybacks. According to this hypothesis, we should expect a lower percentage of firm initiating dividends. The second measure shows that the rate at which non-payers initiate dividend payments has been stable and slightly increasing since early 2000.

3 Model

The facts documented in the previous section suggest that buybacks are significantly more flexible than dividends for firms, but dividends are still a commonly used method for doing persistent payments. I develop a model of heterogeneous firms with agency and payout frictions. The economy is populated by a continuum of firms, a representative household and a government with balanced budget. Labor markets, equity markets and risk-free bonds are competitive. Time is discrete. There is no aggregate uncertainty. I will focus on steady-state stationary equilibrium in which all aggregate variables are constant over time.

Firms are subject to transitory and persistent idiosyncratic productivity shocks. They face financing, payout and agency frictions. The household consumes the production good and supplies necessary labor to the corporate sector.

3.1 Problem of the firm

There is a continuum of firms $I$. In this subsection I describe the problem faced by each firm $i \in I$. Since firms are ex-ante identical, I drop the $i$ subscript for the rest of this subsection.
**Production Technology** Firms are characterized by a decreasing returns to scale production technology

\[
y(k_t, n_t; z_{P,t}, z_{T,t}) = z_{P,t}z_{T,t}k_t^{\alpha}n_t^{\nu},
\]

where \(k_t\) represent capital, \(n_t\) represents labor and \(\alpha + \nu < 1\). Variables \(z_{P,t}\) and \(z_{T,t}\) represent the persistent and transitory idiosyncratic productivity shocks of the form

\[
\log(z_{P,t}) = \rho \log(z_{P,t-1}) + \eta_t \tag{1}
\]

\[
\log(z_{T,t}) = \epsilon_t \tag{2}
\]

where innovations \(\eta_t\) and \(\epsilon_t\) have a normal distribution with mean zero and variance \(\sigma^2_{\eta}\) and \(\sigma^2_{\epsilon}\) respectively. The persistence satisfies \(\rho \in (0, 1)\). Capital depreciates at rate \(\delta\) and has no adjustment costs.

**Firm governance and information structure** The firm can be described by a long-lived board of director who represents all shareholders proportionally (referred hereafter as "shareholder") and a manager who is replaced every period. The firm receives innovations \(\epsilon_t\) and \(\eta_t\) to the transitory and persistent components of productivity every period. At time \(t\), the shareholder cannot see either of the innovations, and therefore can only observe past components of productivity, \(\{z_{P,t-1}, z_{T,t-1}\}\). The manager observes past components of productivity, but
he is also able to observe the innovation to the persistent process $\eta_t$. This allows the manager to infer $z_{P,t}$. This represents manager information advantage relative to the shareholder.

Given available resources $a_{t-1}$ accrued at the end of period $t-1$, the shareholder chooses dividends $d_t$, share buybacks $b_t$, equity issuances $e_t$ and the amount of funds $x_t$ that will be available for the manager (referred hereafter as "funds"). Given funds $x_t$ received from the shareholder, the manager will choose the amount of capital $k_t$ that will be used for production and cash $m_t$ that will earn the risk-free rate $r_t$. Besides using the available funds $x_t$, the manager is allowed to finance a share of capital $(1-\lambda)k_t$ using risk-free debt $l_t$. The parameter $1-\lambda$ represents the collateralizability of capital and $\lambda \geq \delta$. Therefore, capital investment is constrained by the availability of funds, as capital must satisfy $\lambda k_t \in (0, x_t]$. All production, asset trading and labor hiring is realized at the end of the period.

**Manager preferences** The manager receives private benefit from the size of the managed firm $k_t$, i.e. empire building motive. The manager will receive stock-based compensation in the form of a fixed proportion of company shares, which enters linearly into his utility. This means that the manager’s felicity $U^m$ at the end of period is a function of $k_t$ and the stock price $P_t$. The functional form of manager’s felicity function is:

$$U^m(k_t, P_t) = \theta_k g(k_t) + P_t,$$

where the empire-building motive $g(k_t)$ is increasing in capital and concave, i.e. $g'(k) > 0$ and $g''(k) < 0$. The ex-dividend value $P_t$ will be explicitly derived in the next subsection. The parameter $\theta_k$ will control the degree of agency frictions between manager and shareholders.\(^\text{15}\)

**Equity issuance and payout frictions** Equity issuance $e_t$ is subject to issuance convex costs $\Xi(e_t) = \xi_1 e_t + \xi_2 e_t^2$. The quadratic term is motivated by documented evidence that underwriting spreads increase with the size of equity offerings.\(^\text{16}\) Dividend payments are subject to convex downward adjustment costs of the form $\Psi(d', d) = \psi_2 \left(\frac{(d_t - d_{t-1})^2}{d_{t-1}}\right) I(d_t < d_{t-1})$. That is, the cost faced by the firm depends on the dividends paid in the previous period. If shareholder dividend choice is greater than or equal to last period’s choice, firm doesn’t have to pay any extra cost. However, if the shareholder reduces dividends, the firm faces an extra cost that depends on the size of the dividend cut. I chose a quadratic functional form in order to capture convex adjustment cost with only one degree of freedom. Share buybacks are subject to linear costs $\Phi(b_t) = \phi b_t$ that represent compliance costs required to safely engage in open-market buyback operations satisfying the SEC rule guidelines.

\(^\text{15}\)Since managers are replaced every period, dynamic considerations of $g(k_t)$ do not enter into his decisions. Another way to think about this specification is that the manager is not forward-looking into his own bias. However, any other dynamic considerations are still important through their effect on the stock price.

**Taxes** The model considers taxes with full loss offset provisions. Firms face corporate income tax at constant rate $\tau_c$. Capital depreciation and interest expenses can be tax deducted from profits. Household faces a tax rate $\tau_i$ on labor and interest income, a dividend income tax $\tau_d$ and capital gains tax $\tau_g$.\footnote{As is common in the literature, I assume that capital gains are taxed on accrual instead of being taxed on realization. In the US, capital gains are only taxed after trade is realized.}

### 3.2 Recursive Problem

The recursive problem of the firm at each period can be split in three stages. In the first stage, the shareholder enters the period holding a certain amount of resources from last period, observing past dividend payments and past persistent productivity $(a_{-1}, d_{-1}, z_{P-1})$. Shareholder makes decisions about financing, payout and funding $(e, d, b, x)$. In the second stage, the manager observes funding and financing choices from the shareholder. The manager also observes the innovation to the persistent productivity. The manager will choose capital, cash and debt $(k, m, l)$. In the third stage, after both shocks are observed, all decisions are exercised, the manager hires labor in the spot market and produces. Operating profits, undepreciated capital, net cash holdings, and financial profits/losses comprise resources entering next period.

In the third stage, after both shocks are observed, capital $k$ is installed. The labor demand decision is static because it only affects contemporaneous operating profits. Given a market wage $w$, we can derive the operating profit function as

$$\pi(k; z_p, z_T; w) = \max_{n \geq 0} \{(1 - \tau_c)(y(k, n; z_p, z_T) - wn) + \tau_c \delta k\}.$$  

The solution is a labor demand function $n(k, z_p, z_T)$ defined by the first order condition:

$$w = \nu \frac{y(k, n; z_p, z_T)}{n(k; z_p, z_T)}. \tag{3}$$

For the rest of the section we can use operating profits and deal with a single input factor $k$.

In the second stage, the manager observes $z_p$ and the shareholder’s decision on operating funds $x$ and dividends $d$. The manager will maximize his expected utility before observing $z_T$. The manager solves the following problem:

$$\max_{k > 0, m \geq 0} \theta_k g(k) + E \left[ \hat{\beta} V(a(k, x; z_p, z_T), d, z_p) | z_p \right] \tag{4}$$

s.t. \hspace{1cm} \lambda k \leq x \tag{5}

$$m = x - k \tag{6}$$

$$a(k, m; z_p, z_T) = \pi(k; z_p, z_T) + (1 + r(1 - \tau_c))m + (1 - \delta)k, \tag{7}$$

where the price of the stock at the end of the period $P = \hat{\beta} V(a, d, z_p)$ is substituted by the
next-period value function discounted by the shareholder’s stochastic rate \( \beta \). The stochastic discount rate will be constant in equilibrium and determined by the household. The value function \( V(a, d, z_p) \) depends on resources \( a \) and dividend level \( d \) and persistent productivity \( z_p \). The manager will choose capital and net cash holdings \( m = m - l \). Resources will be comprised of operating profits \( \pi(k; z_p, z_T) \) at the end of period, financial profits \( r(1 - \tau_c)(\bar{m}) \), net cash holdings \( \bar{m} \), and undepreciated capital \( (1 - \delta)k \).

This problem gives a capital policy function \( k(x, d, z_p; V) \), a cash holding policy function \( m(x, d, z_p; V) \), and a debt policy \( l(x, d, z_p; V) \). Capital decisions will depend on funding, dividends promised, productivity and the shape of the value function.

In the first stage, the shareholder problem is to maximize equity value \( V(a_{-1}, d_{-1}, z_{p-1}) \) for a level of resources \( a_{-1} \), promised dividends \( d_{-1} \) and past persistent productivity \( z_{p-1} \). The shareholder problem is defined recursively in terms of equity value \( V(a, d, z_p) \) as:

\[
V(a_{-1}, d_{-1}, z_{p-1}) = \max_{\{d, b, e, k(z_p)\}} \frac{1 - \tau_d}{1 - \tau_s} d + b - e + \bar{\beta}E[V(a(k(z_p)), \bar{m}, z_p, z_T), d, z_p)] \tag{8}
\]

subject to:

\[
a_{-1} \geq d + \Psi(d, d_{-1}) + b + \Phi(b) - e + \Xi(e) + x \tag{9}
\]

\[
d, b, e \geq 0 \tag{10}
\]

\[
a(k(z_p), \bar{m}, z_p, z_T) = \pi(k(z_p); z_p, z_T) + (1 + r(1 - \tau_c))(x - k(z_p)) + (1 - \delta)k(z_p) \tag{11}
\]

\[
\theta_k g(k(z_p)) + \bar{\beta}E[V(a(k(z_p), x; z_p, z_T), d, z_p)|z_p] \geq \theta_k g(x) + \bar{\beta}E[V(a(\kappa, x; z_p, z_T), d, z_p)|z_p] \quad \forall x \in (0, x/\lambda], \tag{12}
\]

where the stochastic discount factor is equal to \( \bar{\beta} \equiv \frac{1}{1 + r(1 - \tau_c)/(1 - \tau_s)} \). In the Appendix I show a derivation of the equity value \( V \) using the no-arbitrage condition between the required return to equity and the risk-free rate.

Equation (9) is the resource constraint of the firm at the beginning of the period. Equation (10) expresses the liquidity constraint faced by the manager. The shareholder exerts control over the manager with this constraint. Regardless of the persistent productivity, capital installed by the manager cannot exceed a proportional share of funding. Equation (12) is the manager’s incentive compatibility constraint and it holds with equality if \( \lambda k < x \).

---

18The stated problem only determines capital \( k \) and net cash holdings \( \bar{m} \). The manager is indifferent between any linear combination of \( m \) and \( l \in [0, (1 - \lambda)k] \) that satisfy \( \bar{m} \). In order to match balance sheet liabilities in the data, I assume that at indifference points, the manager chooses to borrow the maximum possible amount. Hence, for any given \( k \) and \( \bar{m} \), we have \( l = (1 - \lambda)k \) and \( m = \bar{m} + (1 - \lambda)k \).
3.3 Stationary Distribution

Given the independently and identically distributed nature of the transitory shocks $z_T$, it is sufficient to describe the evolution of the corporate sector by the cross-sectional distribution of firms $\mu$ over their state $s \equiv (a, d, z_p) \in S$. Thus, $\mu$ constitutes the aggregate state and evolves according to the law of motion $\mu'(s') = \Gamma(z_p', z_T', \mu(s))$.

$$\mu'(A \times D \times Z_p') = \int_S \int_{z_p'} 1_{a'(x(a, d, z_p), d'(a, d, z_p), z_p, z_T)} df_{z_p'} df_{z_T'} df_{z_p} \mu(a, d, z_p).$$

(13)

Note that I’m suppressing the dependence on the wage $w$. The stationary distribution $\mu^*$ satisfies the relationship $\mu' = \mu = \mu^*$. Given a stationary distribution, one can compute the following aggregate quantities:

$$Y = \int_S \int_{z_p'} \int_{z_T'} y(x(a, d, z_p), d'(a, d, z_p), d'(a, d, z_p), z_p, z_T) df_{z_p'} df_{z_T'} df_{z_p} \mu$$

(14)

$$K = \int_S \int_{z_p'} \int_{z_T'} k'(x(a, d, z_p), d'(a, d, z_p), z_p, z_T') df_{z_p'} df_{z_T'} df_{z_p} \mu$$

(15)

$$M = \int_S \int_{z_p'} \int_{z_T'} m'(x(a, d, z_p), d'(a, d, z_p), z_p, z_T') df_{z_p'} df_{z_T'} df_{z_p} \mu$$

(16)

$$N = \int_S \int_{z_p'} \int_{z_T'} n'(x(a, d, z_p), d'(a, d, z_p), z_p, z_T) df_{z_p'} df_{z_T'} df_{z_p} \mu$$

(17)

$$AC = \int_S AC(a, d, z_p) \mu$$

(18)

$$BC = \int_S BC(a, d, z_p) \mu$$

(19)

$$EC = \int_S EC(a, d, z_p) \mu,$$

(20)

representing aggregate output, capital, cash holdings, labor demand, dividend adjustment costs, buyback costs and issuance costs respectively.

3.4 Household

The economy is populated by a representative household with a time-additive utility with felicity for consumption and disutility for labor. Every period the household trades firms’ shares and risk-free bonds. In equilibrium, the household owns all firms, and holds all firm net debt. The household pays dividend taxes, personal income taxes, and capital gains taxes. Consumption, labor decisions, and asset trading at time $t$ occur at the end of period after $\eta_t$ and $\epsilon_t$ are public.

Given the prices observed by the current shares $P(s)$, the distribution of firms $\mu(s)$, the real risk-free rate $r$ and the real wage they receive for their labor effort $w$, households determine
their current consumption $C_t$, labor supplied $N^s_t$, as well as the numbers of risk-free bonds $H_t$ and new shares $\theta_{t+1}(s)$ to purchase. The utility function of the household is given by:

$$\sum_{t=0}^{\infty} \beta^t U^H(C_t, N^s_t),$$

where $\beta$ is the discount factor, $C_t$ represents consumption and $N^s_t$ represents labor supplied.

The utility function satisfies $U_1 > 0, U_{11} < 0, U_2 < 0, U_{22} < 0$ and the Inada conditions. The household pays dividend taxes, personal income taxes and capital gain taxes. The budget constraint is given by:

$$\int_S [(1 - \tau_d)(1 - \tau_g)(P_t(s) + b_t(s) - e_t(s) - P_{t-1}(s)) + P_{t-1}(s)] \theta_t(s) d\mu_t(s) + (1 - \tau_i)H_t + (1 - \tau_i)w_tN^s_t + T_t = C_t + \int_S P_t(s)\theta_{t+1}(s) d\mu_t(s) + H_{t+1},$$

where $P_t$ is the vector of prices for each firm in the state space $s \in S$ and $\theta_t$ the vector of shares owned by the household, $H_t$ denotes risk-free bond holdings and $T_t$ are the transfer from the government. In equilibrium, $\theta_t(s) = 1$ which imply that the household receives all proceeds from share buybacks $b_t$ and supplies all new equity financing $e_t$. The level of bond holdings $H_t$ will be equal to net debt issued by the corporate sector.

In steady state, one can show$^{19}$ that the intertemporal marginal rate of substitution is equal to $\beta$ and the interest rate satisfies:

$$\frac{1}{\beta} = 1 + (1 - \tau_i)r.$$ 

By no-arbitrage, the required return on equity for every firm $s \in S$ must be:

$$\frac{1}{\beta} - 1 = (1 - \tau_d)\frac{E[d'(s)]}{P(s)} + (1 - \tau_g)\frac{E[P'(s) + b'(s) - e'(s) - P(s)]}{P(s)}.$$ 

The first equation determines the interest rate $r$ in steady state and the second equation determines the equity valuation in Equation (8). The first order conditions for labor supply and consumption lead to

$$- \frac{U^H_N(C, N^s)}{U^H_N(C, N^s)} = (1 - \tau_i)w.$$ 

$^{19}$See Khan and Thomas (2008) and Gomes (2001).
3.5 Government

I assume that all tax revenues collected by the government are reimbursed to the household in a lump-sum transfer. The government budget constraint is given by:

\[ T = \tau_c [Y(\mu^*) - w \cdot N(\mu^*) - \delta K(\mu^*) + r (M(\mu^*) - (1 - \lambda)K(\mu^*)) + \tau_d \int_S d'(a, d, z_P) d\mu^*(s) + \tau_g \int_S (b'(a, d, z_P) - e'(a, d, z_P)) d\mu^*(s) + \tau_i [w \cdot N^s(\mu^*) + rS(\mu^*)]. \] (23)

3.6 Stationary Equilibrium

A stationary recursive competitive equilibrium is defined by: a constant wage rate \( w \), a stationary distribution of firms \( \mu^* : S \rightarrow [0, 1]^S \), a value function \( V : S \rightarrow \mathbb{R} \), household’s choice functions \( \{C, N^s, H\} \), firm policy non-negative functions \( \{d, e, b, x, k, m\} \), and aggregate corporate quantities \( \{Y, K, M, N, AC, BC, EC\} \) that satisfy the following conditions:

- given \( w \), firm’s policy functions solve the firm’s problem (8) and \( V \) is the associated value function,
- given \( w \), household choices \( C \) and \( N^s \) satisfy (22),
- aggregate quantities satisfy Equations (14)-(20),
- the labor market clears \( N(\mu^*, w) = N^s(\mu^*, w) \),
- the product market clears \( Y(\mu^*, w) - I(\mu^*, w) - AC(\mu^*, w) - EC(\mu^*, w) - BC(\mu^*, w) = C(\mu^*, w) \),
- the risk-free bond market clears \( (1 - \lambda)K(\mu^*, w) - M(\mu^*, w) = H(\mu^*, w) \),
- the stationary distribution measure satisfies (13).

4 Discussion of the model

In order to understand how buyback regulations affect aggregate investment, we want first to understand how buyback regulatory costs pass through the principal-agent problem inside each firm. Buyback costs affect how shareholder chooses funding decisions. Shareholder funding decisions affect how manager chooses investment.
4.1 The role of the manager

The manager’s main role in the firm is to decide how best to allocate available funds. In particular, the manager can install capital whose returns depend on the firm’s idiosyncratic productivity or save cash whose returns depend on the aggregate economy. Here, I will discuss how manager capital decisions depend on two important inputs.

It is useful to assume for illustration purposes that the value function $V$ is differentiable and concave in $a$. The incentive compatibility constraint (12) could be replaced by a compact first order condition for the manager.

$$\theta_k g'(k) + \beta E \left[ (\pi_k(k, z_P, z_T) - \delta - r(1 - \tau_c)) \frac{\partial V(a(k, \bar{m}, z_P, z_T), \bar{d}, z_P)}{\partial a} | z_P \right] \geq 0. \quad (24)$$

Since the manager knows $z_P$, the expectations of the manager are taken over the realization of the transitory component $z_T$. The second term represents the firm’s optimal decision between allocating funds in capital and cash. In the absence of agency frictions, manager should invest until the marginal benefits of an extra unit of capital $(\partial V/\partial a) \pi_k(k, z_P, z_T)$ equals the marginal cost $(\partial V/\partial a)(r(1 - \tau_c) + \delta)$. However, the first term $g'(k) > 0$ makes the manager act as if capital was more productive than it really is. As a consequence the manager will invest more than the shareholder would like to.

The first relevant input for the manager is shareholder choice of $x$. The funds $x$ approved by the shareholder relax or constraint manager’s budget. A reduction of $x$ below some threshold increases the shadow price of Equation (10) and widens the inequality in (24). Figure 5 illustrates the manager response in this case. Notice that this channel reduces manager’s discretion. Manager is less capable to react when a high productivity $z_P$ realizes.

The second variable of interest for the manager is the sensitivity of the stock price to resources $(\partial V/\partial a)$. Equation (24) shows that when the value function is sensitive to resources is high, manager places more weight on firm profitability $(\pi_k(k, z_P, z_T) - \delta - r(1 - \tau_c))$ than on $g'(k)$. This helps align manager incentives with the shareholder.

4.2 The role of the shareholder

The shareholder’s main role in the firm is to transfer resources in and out of the firm. The costs born to leave money outside the firm involve missing possible investment opportunities. The costs born to keep money inside the firm involve manager overinvestment bias.\textsuperscript{20} What complicates the problem is that transferring money in and out is costly, due to issuance and

\textsuperscript{20}When corporate tax rate $\tau_c$ is larger than income tax $\tau_i$, the firm faces an extra cost of keeping money inside the firm, a penalty on after-tax risk-free return. In this case, cash is more efficiently kept outside the firm.
Figure 5: Comparative statics on the manager decision

Note: The horizontal axis shows the logarithm of persistent productivity $z_p$. The vertical axis shows manager capital policy $k(x, d, z_p; V)$ for $d = 0$, and different levels of $x$ (left), and $(\partial V / \partial a)$ (right).

payout frictions. In this subsection I will discuss how buyback costs change shareholder funding decisions.

The shareholder does not observe $z_p$, but she observes past realization $z_{p-1}$. Knowing manager’s policy rules, the shareholder would like to constraint manager’s overinvesting tendencies by reducing $x$ when her expectations of $z_p$ are low. In order to reduce $x$ the shareholder can reduce equity issuances, increase dividends or increase buybacks. A crucial feature of this model is that when firm has a large amount of resources $a$, reducing $x$ comes at a cost.

Figure 6 shows the optimal choice of the shareholder for a fixed amount of resources and dividends $a_{-1} = a, d_{-1} = 0$ as a function of her expected persistent productivity. The figure shows three different funding regimes the shareholder may choose and how these regimes change with a reduction in buyback costs.

If expected persistent productivity is high enough (i.e. $z_{p-1} > \bar{z}^*$), the marginal benefit of an extra unit of funding inside is greater than the marginal cost of issuing equity $1/(1 - \Xi'(0))$. The shareholder will increase the funds for the manager by issuing costly equity until needed.

If expected persistent productivity is low enough (i.e. $z_{p-1} < \bar{z}^*$), the marginal benefit of funding is lower than the marginal benefit of paying money out. The shareholder will try to
Figure 6: Comparative statics on the shareholder problem

Note: The horizontal axis shows past persistent productivity $z_P$. The vertical axis shows shareholder capital policy $x(a_{-1}, d_{-1}, z_{P-1})$ for $d_{-1} = 0$, and different levels of buyback costs $\gamma$.

Take money out of the firm via a payout in order to leave the manager constrained. Paying dividends is not costly in the present, but it involves an adjustment cost in the future that gets greater with lower expected productivity. That is, the marginal benefit of paying dividends $\frac{1-\tau_d}{1-\tau_g} + \beta V_d(\cdot)$ decreases with the size of payouts. Paying buybacks has a linear cost and its marginal benefit is constant $1/(1 + \gamma)$. This makes buybacks more attractive the greater the excess cash is.

Finally, if expected productivity is between these two cases, the marginal benefit of funding is lower than the marginal cost of equity but higher than the marginal benefits of paying out. In this regime the shareholder is resource-constrained, and funding will be determined by the retained earnings from last period.

Figure 6 shows that a decrease in the cost of buybacks changes shareholder thresholds for those regimes. The marginal benefit of buybacks rises and shareholder is willing to payout at higher threshold. Moreover, since marginal benefit of buybacks is also higher the future, this tends to increase the marginal benefit of extra resources inside the firm next period $\partial V / \partial a$. As a consequence, the issuance threshold decreases, since the shareholder is now willing to issue shares at lower expected productivity.
In summary, lower buyback costs change funding and equity-issuance decision margins, and they also tend to increase the marginal value of more resources $\partial V / \partial a$.

4.3 The effect of lower buyback costs on firm investment

The first effect of low buyback costs comes from funding control. Shareholder reduces funding for low expected productivity. This action effectively reduces manager discretion, capping manager capital decisions as Figure 5A shows. Similarly, shareholder increases funding for high expected productivity. This funding effect will be responsible for a reallocation of resources from low productivity firms to high productivity firms.

The second effect comes from valuation. Since the lower cost of buybacks increases the marginal benefit of an extra dollar inside the firm $\partial V / \partial a$, this means that price is more sensitive to profits than before. When manager compensation is tied to stock price, manager will place more weight on total profits relative to capital than before, increasing the share of resources allocated to cash. This valuation channel will be responsible for the reallocation of resources from capital to cash holding.

While both effects translate into lower capital for unproductive firms, the effect on capital for productive firms is not clear ex-ante. Shareholders of productive firms increase funding, but managers decrease resources allocated into capital. The effect on cash holding is unambiguous. Given the increase in funding and the higher share of it assigned to cash, productive firms should increase their cash holdings.

5 Quantification

To estimate the importance of these channels at the macroeconomic level, I quantify the parameters in the model using Compustat firm data from 2005-2017. I use the estimated model in the next section to analyze a counterfactual economy without buybacks. I chose the period of 2005 to 2017 to capture an economy in a steady state long time after the SEC Rule took effect. This sample is also chosen to be a period without major corporate tax reforms that could have change payout dynamics. It spans the time between the Jobs and Growth Tax Relief Reconciliation Act of 2003, which sharply reduced dividend tax rates, and the Tax Cuts and Jobs Act of 2017 which affected firm’s many reduced corporate tax rates and individual income tax rates.

The first step of the quantification estimates the production function parameters and productivity processes using a dynamic panel approach on public firm panel data using generalized method of moments. The second step picks standard preference parameters from litera-
ture and tax rates from statutory levels. In the third step, I estimate the five parameters that gauge the four frictions (agency, dividend, buyback and equity issuance) using over-identified moments from individual firm cash flow statements and balance sheets.

5.1 Production parameter and productivity processes

Since labor is chosen after observing both shocks, I estimate the labor share \( \nu \) by the labor demand function of the firm in Equation (3). I choose \( \nu \) to be median of the firm average share of factor expenditure in total value-added, as defined by: \( \hat{\nu}_i = T^{-1} \sum_{t \in T} \frac{w_t n_{it} y_{it}}{y_{it}} \), where \( T \equiv \{2005, 2006, ..., 2017\} \). Using the labor demand condition, the profits of the firm as a function of installed capital are:

\[
\pi_{it}(k, z_P, z_T) = F(\nu) \left(z_{Pit} z_{Tit}\right)^{\frac{1-\nu-\alpha}{1-\nu}} k^{\frac{\alpha}{1-\nu}},
\]

and defining log variables as \( \tilde{z} \equiv \log(z) \), we have:

\[
\tilde{\pi}_{it} = \beta_0 + \alpha \tilde{k}_{it} + \frac{1-\nu-\alpha}{1-\nu} (\tilde{z}_{Pit-1} + \eta_{it} + \epsilon_{it}).
\] (25)

By quasi-differences, Equation (25) yields:

\[
\tilde{\pi}_{it} - \rho \tilde{\pi}_{it-1} - b_0 (1-\rho) - b_1 (\tilde{k}_{it} - \rho \tilde{k}_{it-1}) = b_2 (\eta_{it} + \epsilon_{it} - \rho \epsilon_{it-1}),
\] (26)

where \( b_0 = \beta_0/(1-\rho) \), \( b_1 = \frac{\alpha}{1-\nu} \), and \( b_2 = \frac{1-\nu-\alpha}{1-\nu} \). The identification comes directly from the model information structure. In particular, capital is chosen by the manager before observing the transitory shock, which means \( E[k_{it} | \epsilon_{is}] = 0 \) for all \( t \leq s \). Hence, we can use the orthogonality conditions of \( \eta_{it} + \epsilon_{it} - \rho \epsilon_{it-1} \) with \( (k_{t-1}, k_{t-2}) \) and \( (\pi_{t-2}, \pi_{t-3}) \) to solve for \( b_1, b_2 \) using the generalized method of moments in a dynamic panel.\footnote{See Arellano and Honoré (2001)} I use a complete set of time dummies to capture aggregate fluctuations.

To implement this estimation, real profits and capital are calculated at the plant level. The parameters \( \hat{b}_1 \) and \( \hat{b}_2 \) allow me to infer \( \hat{\rho} = .880 \) and \( \hat{\alpha} = 0.287 \) directly. After this, I estimate the residuals of Equations (25) and (26). The standard deviations of these residuals pin down the standard deviations of the innovations to the persistent process \( \hat{\sigma}_\eta = .145 \) and transitory process \( \hat{\sigma}_\epsilon = .138 \).\footnote{In the Appendix I provide a) the algebraic derivations of \( \hat{\sigma}_\eta \) and \( \hat{\sigma}_\epsilon \), and b) robustness measures on the lag selection of the dynamic panel.} My estimated persistence is close to the value of .885 obtained by Cooper and Haltiwanger (2006), which used yearly plant-level data from Longitudinal Research Database (LRD).

The final production parameter is the depreciation rate, which is set to \( \hat{\delta} = 8.7\% \) to match the ratio of corporate investment over capital in the sample.

\[ \hat{\delta} = 8.7\% \]
5.2 Setting household parameters and tax rates

The household felicity over consumption and labor features constant elasticity of substitution

\[ U^H(C, N^s) = \frac{C^{1-\frac{1}{\hat{\phi}}}}{1-\frac{1}{\hat{\phi}}} - \frac{N^{s^{1+\frac{1}{\hat{\chi}}}}}{1+\frac{1}{\hat{\chi}}}. \]

Preferences are chosen using standard valued on the literature \( \hat{\phi} = 1/2 \) and \( \hat{\chi} = 1 \).

The empire-building motive preference of the manager is a concave function of \( k \) with parameter equal to the capital share of the production function:

\[ g(k) = k^\alpha. \]

Taxes are set to match statutory rates of the period 2004-2017, after the main tax reform of 2003, and before the 2017 reform took effect. This period featured stable corporate, dividend and capital gain taxes. The corporate tax, dividend tax and capital gain taxes are set to \( \tau_c = 0.34, \tau_d = 0.15, \tau_g = 0.15. \) The income tax is set to \( \tau_i = 0.25 \), the corresponding statutory rate for the median household in the US.

5.3 Matching model implied moments to payout moments

The friction parameters are matched to relevant moments calculated from individual firm cash flow statements and balance sheets. First, the coefficient of collateralizability \( 1 - \hat{\lambda} = 0.35 \) is chosen to match the ratio of long-term debt over physical capital. The rest of the moments are estimated jointly, but their main identification channel is listed in Table 1 and explained below in detail.

The agency parameter \( \theta_k \) is estimated mainly by the share of financial assets relative to capital, and by the amount of operating profits relative to capital. When agency frictions are low, it means that manager is disciplined enough to choose high levels of cash when facing high resources, which in the data translate to financial assets. Similarly, low agency frictions also imply that capital is invested on firms with high idiosyncratic productivity, leading to higher operating profits relative to capital.

The dividend adjustment cost parameter is estimated by the average dividend growth of firms which choose to raise dividends and by the percentage of public firms paying zero dividends. A low adjustment cost implies that less firms are willing to stay zero dividends (extensive margin) and the firms that raise dividends will be less afraid to increase them by a larger amount.

The linear buyback cost is estimated by the value of buybacks as a share of payouts. When cost is lower, firms buy back more shares. The linear issuance cost is associated with
Table 1: Model matched moments to data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Moment</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \theta_k )</td>
<td>.86 Financial Assets/Capital</td>
<td>.16</td>
<td>.16</td>
</tr>
<tr>
<td></td>
<td>Operating Profits/Capital</td>
<td>.17</td>
<td>.16</td>
</tr>
<tr>
<td>( \psi )</td>
<td>10 Mean Positive Dividend Growth</td>
<td>.40</td>
<td>.37</td>
</tr>
<tr>
<td></td>
<td>% Firms paying ( d = 0 )</td>
<td>.63</td>
<td>.71</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>.53 Buybacks/Payouts</td>
<td>.52</td>
<td>.50</td>
</tr>
<tr>
<td>( \xi_1 )</td>
<td>.13 Issuance/Profits</td>
<td>.10</td>
<td>.09</td>
</tr>
<tr>
<td>( \xi_2 )</td>
<td>.08 Capital dispersion (( \sigma_i(K)/K ))</td>
<td>3.1</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Notes: The table shows five friction parameters (\( \theta_k, \psi, \gamma, \xi_1, \xi_2 \)) from the model and seven relevant model moments matched firm cash flow statements and balance sheet data. Yearly data from Compustat 2004-The moments in the data are: aggregate financial assets as a share of installed capital, aggregate operating profits as a share of installed capital, average dividend growth across firms that increase dividends, percentage of public firms paying zero dividends, total money paid out as buybacks as a share of payouts, total money raised by equity issuances as a share of corporate profits, and mean cross-sectional dispersion of capital among public firms.

the level of equity issuances. Finally, the quadratic term on issuance cost helps to control the dispersion of capital. A high quadratic term in the issuance cost prevents firms to accumulate capital quickly, leading to lower dispersion.

6 Results

In this section I test the model performance in replicating dividend and buyback dynamics. I then estimate the aggregate and distributional effects of the buyback rule change by computing a stationary equilibrium shutting down the buyback mechanism. Then, to understand how effectively buybacks mitigate agency frictions, I compare the efficiency of this effect relative to a benchmark model where agency frictions don’t exist. Finally, I calculate the long-term welfare effect of buybacks under different specifications.
6.1 Payout dynamics

I test the model by simulating a series of transitory and persistent idiosyncratic shocks on a distribution of firms in stationary equilibrium. If the model frictions are a good representation of how firms perceive the different payout costs, then the model should be able to replicate dividend and buyback dynamics.

The left side of Figure 7 shows the non-parametric regression coefficient of future buyback changes on current buyback changes on the data. I perform the same regression on the model simulations and show that the persistence of buyback payments matches the data coefficients at all points in the distribution of buyback changes. Buybacks are highly transitory, which means that buyback payments will revert quickly to zero. After a positive change, the firm will on average revert 30-60% of that change for the next period. Further, the degree of reversion slightly increases with the magnitude of the change. The reason we don’t see the same pattern on the negative axis is that buybacks are a nonnegative process. Negative buyback changes in general are not followed by a positive reversion to zero.

The right side of Figure 7 shows us the performance of the model on dividend dynamics. The non-parametric regression on the model simulations matches the data coefficients at all positive points in the distribution, but it departs on the negative side. The model struggles to predict future dividend changes after significantly negative dividend changes. The main reason of this discrepancy is the convexity of the downward adjustment cost function. When firms in the model want to decrease dividends, they prefer to do it very smoothly across periods. Hence, negative dividend changes in general predict other negative dividend changes. However, the histogram of dividend changes in Compustat at the top shows that this is not a big problem for the model overall predictions. The share of firms decreasing dividends is very small. In this sense, the adjustment cost accurately represents the perception of firms while they are increasing dividends, or maintaining them constant, successfully preventing them from decreasing dividends most of the time.

6.2 Effect of buyback rule change

After I match the modeled economy to Compustat data on the period 2004-2017, I compute a stationary equilibrium in a counterfactual model without available buybacks. This can be achieved by raising $\gamma \to \infty$ and it will represent an economy in the absence of the rule change. The results of the counterfactual analysis are shown in Figures 8P.
Notes: The figures show the distribution of nonzero payout changes (top), the nonparametric regression fit of the future payout changes on current payout changes normalized over current sales on panel data of public firms from 2004 to 2017 (bottom). 95% confidence intervals with bootstrap errors in light blue. Data is taken from income and cash flow statements of all firms with at least ten consecutive years in Compustat. The model regression coefficients were obtained after 10,000 simulations on a distribution of 3,000 firms. Dividend and buyback changes are trimmed at 5% and 95% for both data and model coefficient estimations.
6.2.1 Capital and cash reallocation

For each model, I calculate the aggregate amount of capital and cash installed by firms for any given persistent component of productivity. Figure 8 shows the predicted change in aggregate capital and cash allocation before and after the buyback rule.

The funding channel of the buyback rule allows shareholders of unproductive firms to reduce manager funding. These resources flow into productive firms which increase manager funding. This effect will generate a reallocation of resources from unproductive to productive firms. These resources can be allocated in both capital and cash.

The stock price channel changes managers’ behavior. As we saw in Section 4, managers with unconstrained funding will reduce the amount of capital allocated due to the change in price sensitivity. Thus, even though managers of productive firms receive more funding, they may still reduce capital. The magnitude of the stock price channel will depend on how many managers are unconstrained, and the size of the change in price sensitivity. Figure 8 at the left shows that this price effect ends up being larger than the funding effect for medium-high productivities, where managers end up reducing capital despite an increase in funding. For higher productivities, capital increases by a small amount, showing that the funding effect is

Figure 8: Capital and cash reallocation across persistent productivity
Note: The horizontal axis shows the logarithm of persistent productivity $z_p$. The vertical axis shows aggregate capital (left) and aggregate cash (right) owned by firms on each persistent productivity bin in the model. The figures show the aggregate allocations before the buyback rule (light blue) and after the buyback rule (dark red).
Table 2: Changes in concentration by public firms

<table>
<thead>
<tr>
<th>Share of Assets</th>
<th>Financial Assets</th>
<th>Capital Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>24.1%</td>
<td>16.3%</td>
</tr>
<tr>
<td>50%</td>
<td>18.8%</td>
<td>14.2%</td>
</tr>
</tbody>
</table>

Note: The table measures changes in asset concentration by showing the top share of Compustat firms that own 75% and 50% of the total capital and financial assets during the period of 1970-1982 and 2010-2017. The share of firms holding 50% and 70% of the financial assets in the economy has decreased. The concentration in financial assets among public firms has increased by more than the concentration of capital assets.

larger than the price effect due to the number of constrained managers.

The reallocation of cash is represented at the right of Figure 8. The funding channel affects cash in the same way as it affects capital, decreasing the funding levels for unproductive firms and increasing them for productive firms. The price effect will have the opposite effect on cash. Unconstrained managers will always increase the amount of funds allocated to cash and constrained managers will not decrease it. Thus, cash will in general increase by a large amount on productive firms: due to the increase in funding and the increase in price sensitivity.

In summary, the funding channel transfers resources from unproductive to productive firms while the stock price channel transfers resources from capital to cash. One prediction of this model, as Figure 8 suggests, is that we should observe greater changes in cash concentration relative to the changes in capital concentration. Table 2 shows the share of public firms that held 75% of the amount of capital and cash owned by the publicly listed corporate sector before 1983 and in the last decade. The share of public firms that hold 75% of the financial assets decreased by 7.7 percentage points. This represents a greater increase in concentration change than the change in capital concentration of public firms, which is negative.\(^{23}\)

\(^{23}\)This does not mean that capital concentration in the corporate sector has decreased. The reason we probably see a decrease in concentration of capital in public firms is a shift in the composition of public firms (Kahle and Stulz, 2017). That is, the left tail of the firms has exited from public listing, a pattern beyond the scope of these model. What these results highlight is that cash concentration has increased even more than the observed change in composition of publicly listed firms.
Figure 9: Trends in corporate ratios: model and data

Note: The figures show investment, financial asset and profitability ratios from the model before and after the buyback rule (left), and the implied change compared to the changes in the US nonfinancial corporate sector for the periods 1960-1982 and 2010-2017 (right). Data is obtained from the National Income and Product Accounts. Variable definitions located in the Appendix.

6.2.2 Aggregate effects

The model predicts important changes when these distributional shifts are aggregated. The left part of Figure 9 shows the level of three important corporate ratios for the baseline model and its counterfactual computation. The quantities observed are investment as a share of total corporate profits, the size of financial assets relative to capital and the profitability of capital.

The quantification of the main model leads to an amount of investment as a share of profits (54%) that matches Compustat data. The counterfactual level of investment share is 62%. The implied decline in investment share shows that the strength of the stock price channel and the reduction in resources of unproductive firms is sufficient to counteract the increase in resources of productive firms.

Just by looking at this ratio, it is not clear whether the decline in the investment share of profits of −7.6 percentage points is due to a decline in investment or by an increase in total profits. A decomposition of this ratio shows us that the decline in investment is responsible for −6.3 of those −7.6 percentage points. The rest of the decline is driven by total profits, which are the sum of operating and financial profits. Operating profits have slightly decreased,
which means that the increase in financial profits, consequence of the rise of cash holdings, is responsible for the rest of the decline in investment as a share of profits.

The model predicts an increase in cash holdings as a share of capital from 6.8% to 16.0%, implying an increase in cash holdings of 9.2 percentage points. Just as above, this is driven by the fact that the stock price channel is transferring resources from capital to cash through unconstrained managers. Finally, the third trend is an aggregate measure of the capital reallocation results from last subsection. Since capital is reallocated from unproductive to productive firms, the measured profitability of capital increases from 15.1% to 16.7%.

Since the modeled economy on the period 2004 – 2017 is matched to firm-level Compustat data, it will not perfectly match the data from national accounts shown in Figure 2. The financial assets-to-capital ratio and the capital profitability are very similar between the two samples (16.0% to 14.6% for financial assets and 16.7 to 14.4% for profitability). However, investment shares show a difference between the level of 54.1% on Compustat and the level of 65.1% on the National Accounts. First, the corporate sector includes private firms which have different investment and governance behavior. Second, the national Accounts include an estimated measure of intangibles in the capital formation, whereas my main quantification in Compustat does not.

The right side of Figure 9 compares the predicted changes in the model with the observed changes in the national accounts. The decline in investment share accounts for 48% of the observed decline in the National Accounts investment share. The increase in cash holdings as a share of capital explains 88% of the observed increase in financial assets relative to capital. Finally, the model-implied increase in capital profitability explains 47% of the observed increase in national accounts.

It’s important to note that the increase in corporate net cash holdings does not represent a significant change in the amount of safe assets in the economy. Since the household owns all the firms, the end effect of the buyback mechanism is that household holds less cash directly and more cash through the firms. Firms are holding more cash because buybacks allow them to fulfill that function more efficiently. Therefore, the corporate sector becomes more valuable. The model predicts a noticeable increase in the corporate sector market capitalization relative to output of 94 percentage points. While part of this increase is due to the increase in operating profits per unit of capital, a large part of it is closely tied with the cash holding function they now fulfill.

See Gutierrez and Philippon (2017) who find that the intangibles power in explaining investment decline is limited.
Table 3: Profitability and capital gap relative to benchmark model

<table>
<thead>
<tr>
<th></th>
<th>Profitability gap</th>
<th>Capital gap</th>
<th>Output gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before rule</td>
<td>−1.97</td>
<td>+3.40</td>
<td>−11.00</td>
</tr>
<tr>
<td>After rule</td>
<td>−0.31</td>
<td>−7.08</td>
<td>−9.16</td>
</tr>
</tbody>
</table>

Note: The table shows the aggregate levels of profitability, capital and output of the model economy before and after the buyback rule relative to the model before the buyback rule without agency frictions ($\theta_k = 0$). The value of the parameters after the rule are estimated in Table 1. The model economy before the rule is computed by counterfactually setting $\gamma \to \infty$.

6.3 Efficiency of buyback rule

6.3.1 Allocative efficiency

The macroeconomic efficiency of the buyback rule can be analyzed by comparing the capital reallocation originated by the buyback rule with a benchmark model that features no agency distortions (i.e. $\theta_k = 0$). This exercise will measure how effective buybacks are at mitigating the macroeconomic distortions generated by agency frictions.

As seen in the previous subsection, the buyback rule improves profitability mostly through capital reallocation. Table 3 shows that relative to the benchmark model, the profitability gap has been greatly reduced from −1.97 to 0.31 percentage points. The buyback rule pushes profitability closer to the benchmark model. The second column of Table 3 shows that the gap in aggregate capital levels switched signs. This means that if we were to measure aggregate investment, we would conclude that the economy went from having too much investment, to having too little investment relative to the model without agency frictions.

Figure 10 shows the capital allocation in the three economies. The buyback rule is effective at reducing excess capital from low productivity firms. But it does not increase enough the resources of high productivity firms. While the gains from the price effect incentivize managers to invest optimally while using their advantaged information, the gains from the funding effect are limited to the information that is available to shareholders. The increase in shareholder control brought by the funding effect reduces manager discretion, but by doing so the firms lose their informational advantage.
6.3.2 Aggregate efficiency

Once we consider the effects on the household, I compare the long-term welfare differences represented by the two steady-state economies. This comparison does not represent the full welfare impact of the buyback rule because it ignores transition effects. Nonetheless, I find that the difference in long-term welfare is sizable. Table 4 shows that the welfare under the buyback rule is 6.4% higher in consumption equivalent units. Out of this difference, 4.5% of it is due to an increase in consumption and 1.8% is driven by a decrease in labor. Labor wages increase by 5.9%, due to the increase in aggregate productivity.

One characteristic of the model is the presence of three different frictions that represent firm financing constraints, issuance costs, dividend adjustment costs, and buyback costs. Since these frictions impact the aggregate resources in the economy, an important question about this model is: what do these costs represent? In particular, it is important to establish whether they are wasted resources for the economy, or transfers to a different agent. If these costs represent payment to lawyers, or administrative costs, there is an argument for the latter. If the adjustment costs work more as a representation of market volatility or intermediation inefficiencies, then they should be treated as wasted resources.
Table 4: Differences in long-term welfare by the buyback rule

<table>
<thead>
<tr>
<th>Frictions</th>
<th>Δ%\textit{W}elfare(CE)</th>
<th>Δ%\textit{Total}</th>
<th>Consumption</th>
<th>Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reimburse</td>
<td>6.4%</td>
<td>4.5%</td>
<td>1.8%</td>
<td></td>
</tr>
<tr>
<td>Waste</td>
<td>2.9%</td>
<td>2.8%</td>
<td>0.1%</td>
<td></td>
</tr>
</tbody>
</table>

Note: The table shows the percentage differences in consumption equivalent units between the model after the buyback rule and the counterfactual model without the buyback rule. The table also shows the decomposition of that percentage in consumption increase and labor decrease.

I evaluate welfare using the two extreme assumptions. The baseline model treats the three financing frictions as payments to other sectors in the economy. The costs are therefore reimbursed to the household. In the other extreme case, I treat all costs as wasted resources. The second case impacts the size of welfare difference, but not its sign. The reason this assumption reduces welfare gains under the buyback rule is that firms issue more shares and use more buybacks. This high churn of equity increases the amount of wasted resources, which impact the household wealth. However, these losses are not large enough to offset the first-order welfare increases through productivity gains. Welfare still increases by 2.9%. In the baseline model, two thirds of the welfare difference are due to an increase in consumption, while one third is due to a decrease in labor supply. In the alternative model, labor supply remains almost constant due to the wealth effect of the wasted resources and almost all the difference in long-term welfare is due to higher consumption.

6.4 Implications for dividend tax changes

This subsection describes the effect of dividend taxes on firm investment. In this model, the effect of dividend taxes depends on the dynamics and distribution of firms across two dimensions. The first one is commonly studied in the corporate taxation literature and measures whether the marginal source of finance is new equity issuances or retained earnings. The second dimension is unique to this model and measures whether the manager is unconstrained or not by funding. The first dimension determines whether shareholders bring resources into the firm or not and the second dimension determines whether the manager invests in capital or in risk-free cash.

In traditional models of firm investment where the same agent has ownership and control of the production technology, the firm equalizes the marginal cost of financing with the after-
Figure 11: Dividend tax effect on capital reallocation

Note: The horizontal axis shows the logarithm of persistent productivity $z_P$. The vertical axis shows aggregate capital owned by firms on each persistent productivity bin in the model. The allocation of capital is shown in the estimated model with dividend taxes $\tau_d = 15\%$ (solid dark red), and after a hypothetical tax increase $\tau_d = 20\%$ (dashed light blue).

tax marginal return of investment. The effect of a dividend tax $\tau_d$ on investment depends on its effect on both sides of that relation. In a two-period model, a decrease in $\tau_d$ always increases the after-tax marginal return. If the marginal source of financing is new equity issuances, the marginal cost doesn’t depend on $\tau_d$, and hence lower $\tau_d$ spurs investment. This is known as the "Old View" of corporate taxation. However, if the marginal source of financing is retained earnings, a decrease in $\tau_d$ will also raise the marginal cost of financing, because any extra dollar is coming at the opportunity cost of not paying dividends. In this case, reducing $\tau_d$ would have no effect on investment. This is the "New View" of corporate taxation.

In a dynamic model of heterogeneous firms, as Gourio and Miao (2010) explain, two considerations make the analysis more nuanced than the simple comparative statics just described. First, given heterogeneity, different firms may be in different financing regimes. Thus, the aggregate tax incidence depends on where the distribution of firms is located. Second, the dynamic nature makes the effect of taxes on the marginal return less trivial. For instance, even if the current marginal source of finance is new equity issuance, taxes might not influence marginal investment if the returns are used to reduce equity issuance in the future.

In this model, a third consideration arises from the fact that financing decisions and investing decisions are taken separately. The shareholder trades off the marginal cost of financ-
ing with the marginal benefit of an extra unit of funds \( x \), whereas the manager gauges the marginal benefit of investing in capital \( k \) versus saving in cash \( m \). For taxes to have incidence on investment, it is not sufficient that the shareholder increases funds. Those marginal funds need to be allocated in capital. Similarly, even if lower taxes do not incentivize the shareholder to increase funds, they might still affect investment by changing the manager’s private return on investment relative to cash.

Let’s take the case where the shareholder responds significantly to a decrease in \( \tau_d \) and increases \( x \). If the manager is funding constrained (i.e. if Equation (24) is strict inequality) he will respond one-to-one to any marginal increase \( x \) by fully allocating it in \( k \). However, if the manager is at an interior solution (i.e. Equation (24) is an equality) then extra funds will not change much the capital allocation. The increase in \( x \) will only have a second order impact via a reduction of \( \partial V / \partial a \) at low levels of resources, but the increase in the marginal after-tax return to investors (the stock price channel) may increase \( \partial V / \partial a \). Overall, if manager is unconstrained, the firm may not increase investment even if the marginal source of financing is equity.

I calculate the effects of an increase in dividend taxes from 15% to 20% in the quantified model after the buyback rule. Figure 11 shows the effects before and after the hypothetical dividend tax increase. A tax increase would decrease investment mostly among firms which were issuing equity and whose managers were constrained. These firms tend to be located on the middle part of the distribution because it is more expensive for them to afford an unconstrained manager. The resources will be reallocated to the medium-high part of the productivity distribution, i.e. firms whose manager is mostly unconstrained. The reduction in after-tax marginal returns would reduce manager’s weight on profits relative to the empire-building preferences and lead him to invest more.

Overall, the increase in dividend taxes of 5% would decrease aggregate investment by 1.7% but would increase profitability by 1.4%. Under the baseline model that reimburses frictional costs to households, the tax increase would increase consumption equivalent welfare by 0.36%. This effect is driven by the increase in labor income driven by higher firm profitability.

7 Conclusion

This paper studies the long-term effects of open market buybacks on capital allocation and welfare. To do that, I focus on two features of public firms: 1) the relative difference in persistence between buybacks and dividends and 2) the use of high-powered incentives in public firms to control managers with misaligned incentives. I propose a new quantitative
general equilibrium model of heterogeneous firms with agency, financing and payout frictions. I match the model to micro data on public firms and compute a counterfactual economy without the possibility of buybacks to analyze the effect. I find that the 1982 buyback rule improved the ability of firms to control manager funding, which shifted resources from unproductive to productive firms. Moreover, by changing stock price sensitivity, the ability to pay through buybacks improved stock-based compensation ability to align managers incentives which shifted resources from capital assets to safe financial assets. I estimate that share buybacks can account to a large extent for the observed decline in investment, the increase in capital profitability and the increase in corporate financial assets in the last four decades.
References


2013, 1–58.


