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Highlights

- to provide stylized facts about the savings decisions of the US corporate sector
- to develop an explanation for the financing behavior of the US corporate sector
- to quantitatively evaluate the importance of the explanation proposed

Taxes and Capital Structure: Understanding Firms' Savings*

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Abstract

The U.S. non-financial corporate sector became a net lender to the rest of the economy in the early 2000s, with close to half of all publicly-traded firms holding financial assets in excess of their debt liabilities. We develop a simple dynamic model of debt and equity financing where firms strive to accumulate financial assets even though debt is fiscally advantageous relative to equity. Moreover, firms find it optimal to fund additional financial asset holdings through equity revenues. The calibrated model matches well the distribution of public firms' balance sheets during the 2000s and correctly predicts which firms are net savers.

Keywords: Corporate savings, debt, equity, dividend taxation.
JEL classification: H21, E61.

1 Introduction

Since the early 2000s the U.S. non-financial corporate sector has emerged as a net lender to the rest of the economy. The sector's net financial asset (NFA) position, defined as the difference between financial assets and debt liabilities, has averaged over 3 percent of the value of its tangible assets (capital henceforth) for the period 2000-2007. Net savings are also widespread at the firm level. More than 40 percent of publicly-traded firms in the U.S. averaged a positive NFA position for the period, with some firms holding net financial assets in excess of their capital.[1]

The magnitude and prevalence of firms' savings are surprising since debt holds a substantial fiscal advantage over equity, as firms can expense interest payments from their taxable corporate income while dividends and capital gains are taxed. Any favorable tax treatment of debt breaks the well-known Miller-Modigliani irrelevance result, implying that firms should be as leveraged as possible and minimize their reliance on equity to finance investment. The data clearly suggest the opposite pattern as firms with a positive NFA position—that is, more financial assets than debt—must have equity in excess of their capital.

Understanding the size and distribution of corporate savings across firms is important for several reasons. Foremost, internal funds allow firms to insulate themselves from the vagaries of financial markets. Thus any attempt to quantify the importance of financial frictions or shocks must account for the observed financial positions of firms. More broadly, understanding the firms financial decisions is indispensable to pin down

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[1] The data were quite different in the 1970s and 1980s when the U.S. corporate sector was a net debtor, borrowing as much as 20 percent of its capital. The increase in NFA from 1970 to 2000 echoes a dramatic rise in cash holdings by U.S. firms (see Bates et al. (2009), among others) and a decrease the firms' long-term liabilities. Section 2 and Appendix A contains data definitions and sources.

the cost of capital and, for example, to evaluate the effects of the dividend, capital gains, and corporate tax rates on investment and the capital-to-output ratio.

In this paper we argue that the fiscal advantage of debt can actually drive firms to accumulate financial assets in a fully dynamic, stochastic setting. Consider a risk-neutral entrepreneur, subject only to statutory tax rates and a debt limit. In order to minimize the fiscal burden, the entrepreneur will seek to finance investment exclusively through debt, only resorting to equity when reaching the debt limit. This introduces differences in the cost of capital across firms with different internal funds, or net worth. A firm with low net worth must resort to equity to finance its investment, and incurs in a high cost of capital in doing so, while a firm with available internal funds can use these to reduce its cost of capital. Quite naturally, the firm's value becomes concave as a function of its net worth solely on the basis of the differential tax treatment and the debt limit. The concavity of the firm's value gives rise to a "precautionary motive"—akin to the behavior of a risk-averse household—to accumulate financial assets as the firm seeks to minimize future reliance on equity issuance.

Our argument is formalized with a simple model of heterogeneous firms. By design, the capital structure of a firm is irrelevant in our model if debt and equity distributions are taxed equally.[2] Risk-neutral entrepreneurs operate a decreasing-returns-to-scale technology. Capital is determined by the firm's investment in the previous period, which can be financed by internal funds, debt or equity. Firms face a non-default constraint on their fixed-income liabilities.[3] Equity distributions are exogenously specified to be positively correlated with the firm's cash flow and capital.

In our model, firms find it optimal to fund additional financial asset holdings with equity revenues, despite the latter's higher cost. Using equity to fund acquisitions of financial assets increases the internal funds available to the firm in the event of negative cash flow shocks, safeguarding the firm from having to issue *further* equity at later dates when the financing costs will compound. The intuition is as follows. A firm with low net worth has no choice but to issue equity to satisfy its financing needs due to the presence of a borrowing constraint. Since a large fraction of the cash flow is then committed to shareholders, the firm's net worth increases only very slowly, preventing the firm from expanding investment and resulting in high finance costs over a prolonged period. An additional dollar of internal funds allows a low-net worth firm to reduce equity reliance in the present *and future periods*, enabling the firm to build its net worth faster and escape being financially constrained in the event of a negative shock. That is, equity acts as a form of insurance, effectively transferring resources from future states where the firm experiences positive shocks to those featuring negative shocks that deplete the firm's net worth. The firm values internal funds above the one-time cost of equity and is thus willing to raise equity revenues to build its financial asset holdings when it has a chance to do so.

The model is calibrated to statutory tax rates for corporate earnings, interest income, dividends and capital gains. Given our focus on the firms' financial decisions, the productivity process incorporates both operational losses and investment opportunities, which are key determinants of the observed levels of financing needs in the data.[4]

The model provides an excellent match of the cross-firm distribution of NFA in the period 2000-2007, predicting a large share of firms with positive NFA: 42 percent in the model versus 44 percent in the data. The model also matches the median, standard deviation and various percentiles of the distribution of ratio of NFA to capital. Importantly, the model generates the right tail of the NFA distribution found in the data and confirms that, as in the data, firms with net savings have higher investment rates, more revenues and equity, and build up their equity faster.

[2]This narrow view of the relative costs of equity and debt allows us focus on the role of taxes. There are other important factors influencing the relative costs and benefits of equity, such as floatation costs, agency considerations, and deadweight loses associated with liquidation. See Frank and Goyal (2008) and Tirole (2006) for an overview of empirical and theoretical work.

[3]Borrowing or debt constraints have received plenty of attention in the related literature: See Korajczyk and Levy (2003), Almeida et al. (2004), Bolton et al. (2011), Riddick and Whited (2009), among many others.

[4]Standard specifications in the literature are designed to match revenue dynamics. These specifications do not generate enough finance demand because investment is driven by positive productivity shocks, which also bring a cash flow windfall. It is thus too easy for the firms to self-finance. The role of negative cash flows is also emphasized in Gorbenko and Strebulaev (2010).

The time-variation in statutory dividend tax rates in the US provides an additional opportunity to pit the model against the data. According to our calculations, reductions in dividend taxes in the 1980s and 1990s, up to the tax reform of 2003, reduced by half the fiscal cost of equity relative to debt.[5] Once the higher relative cost of equity in the 1970s is accounted for, our model predicts that firms rely less on equity to accumulate financial assets, and thus have lower NFA and equity positions. Quantitatively, the mean ratio of NFA to capital is predicted to be negative, at -0.06, compared to -0.12 in the data. The model is actually spot on regarding the median ratio of NFA to capital, -0.16 in the model versus -0.17 in the data, and quite close regarding the predicted share of firms with positive NFA: 32 percent in the model compared to 27 percent in the data. At the same time, the shift in the firms' financing from net borrowers to net lenders has only modest effects on investment. The capital-to-output ratio predicted by the model for the 1970s is only a bit below — by 2.7 percent — the capital-to-output ratio in the 2000s. Indeed, the large shift in balance sheet positions indicate that, given time, the firms are able to substantially insulate the cost of capital from dividend taxes. The model's predictions for the cross-sectional distribution of NFA line up even closer to those observed in that decade if the calibration incorporates lower idiosyncratic risk, as observed for firms in the 1970s.

The distinctive feature of our empirical work is the focus on the net financial asset positions of firms. Previous work had pointed out an increase in cash holdings by U.S. firms (see, for instance, Bates et al. (2009), Opler et al. (1999), Sanchez and Yurdagul (2013) and others). Other work, though, had instead argued that U.S. corporations remain highly leveraged (see, for instance, Graham et al. (2014), Kalemli-Ozcan et al. (2012) and others).[6] While there is certainly much to be learned from the gross asset and liability positions of firms, looking at the NFA allows us to evaluate whether firms demand or supply savings to the rest of the economy and, arguably, NFA is the correct summary variable for the internal financial resources of the firm.

Any structural, dynamic model of corporate finance, including ours, owes a great debt to the seminal contributions by Gomes (2001) and Hennessy and Whited (2005, 2007), among others.[7] These models seek to explain many interesting firm-level findings in empirical corporate finance typically by including various adjustment or liquidation costs to match firm-level elasticities.[8]

Our model emphasizes the close link between taxes and NFA accumulation due to a classic precautionary-savings motive.[9] Other work has argued for the importance of precautionary savings in firms, albeit due to different mechanisms. Boileau and Moyen (2009), for example, rely on convex costs of equity adjustments, an assumption also present in Hennessy and Whited (2007), inter alia. In their modeling of private-equity firms, Shourideh and Zetlin-Jones (2012) instead assume that ownership is concentrated at the hands of a risk-averse entrepreneur. The possibility of default with dead-weight costs can also create the necessary motive for precautionary savings.

There have been other hypothesis for the accumulation of financial assets recently put forward in structural models. Zhao (2015) argues that about two-thirds of the increase in corporate cash holdings can be accounted for by the increase in cash flow volatility. Karabarbounis and Neiman (2012) instead relate secular changes in the cost of investment to changes in corporate savings. Falato et al. (2013) propose a mechanism linking intangible assets to firm's cash holdings. Morellec et al. (2013) and Della Seta (2013) argue that in the presence of financing constraints, product market competition increases corporate cash holdings because it increases the risk that a firm will have to raise costly external finance. Ma et al. (2014) and Lyandres and Palazzo (2011) also focus on the role of competition for corporate cash holdings, but at the industry level, with the cost of innovation and R&D providing the link between the two. Finally, Gao (forthcoming) argues that the switch to just-in-time inventory system has contributed to the rise in cash holdings of the US manufacturing firms. To the best of our knowledge, we are the first to highlight the key role that taxes—which

[5] See also Poterba (2004) for further discussion on the taxation of corporate distributions.

[6] In our data set there is both an increase in cash holdings and a decrease in liabilities—mainly long-term debt—are behind the rise in the NFA.

[7] Other closely related work include Whited (2006) and DeAngelo et al. (2011).

[8] For example, Hennessy and Whited (2005) propose a model that generates a negative relationship between leverage and lagged measures of cash-flows, debt hysteresis, and path-dependence in financing policy.

[9] The motive has a long tradition in the field of household finance, see Carroll (1997) for a seminal contribution.

can be directly observed—play in the firm's accumulation of financial assets.

Our work is also closely related to a growing literature studying the interaction of financing decisions with the real variables. Cooley and Quadrini (2001) use a model of industry dynamics to study the role of financial frictions and persistent productivity shocks for firm dynamics and their dependence on firms' characteristics, such as initial size and age. Cooley and Quadrini (2001), however, do not allow for capital accumulation and abstract from the role of taxes.[10] Jermann and Quadrini (2012) also formalize a model of debt and equity financing, but are interested in the cyclical properties of external finance and the effects of 'financial shocks'.[11] This interest is shared by Khan and Thomas (2013) who study the aggregate effects of financial shocks in a model with partial investment irreversibility, matching the distribution of investment and borrowing across firms. Unlike us, though, Khan and Thomas (2013) do not allow for equity financing. Uhlig and Fiore (2012) focus on the composition of corporate debt between bank finance and bond finance and its dynamics and effects on investment and output during the 2007–09 financial crisis. Relative to these studies our contribution is to focus on taxes and the cross-sectional distribution of firms' financial assets/debt and equity positions.

Our focus on the role of corporate and capital-income taxes has a long tradition in finance and macroeconomics. On the theoretical front, the literature has developed a number of insights for why taxes should matter for the corporate capital structure (see Modigliani and Miller (1963), Miller (1977), DeAngelo and Masulis (1980), and others). Recent empirical work has confirmed a statistical association between taxes and capital structure decisions of firms (Graham (1996, 1999, 2003), Fan et al. (2012), Desai et al. (2004), Faccio and Xu (2015), and others). In related work, McGrattan and Prescott (2005) link tax and regulatory changes affecting the U.S. shareholder distributions to large secular movements in the value of U.S. corporations. Following the Jobs and Growth Tax Relief Reconciliation Act of 2003 there has also been a renewed interest in how dividend and capital gains taxes affect capital structure and investment. See, for example, Chetty and Saez (2005, 2006), Gourio and Miao (2010), and Gourio and Miao (2011).

The paper is organized as follows. Section 2 documents the key facts regarding corporate NFA for the period 2000-2007. Section 3 describes the model setup and defines the industry equilibrium. A discussion on the model's ability to generate a simultaneous demand for equity and net savings is in Section 4. Section 5 documents our calibration and Section 6 discusses the model fit and the key quantitative determinants of positive NFA. Section 7 contrasts the model predictions for the high cost of equity environment of the 1970s. The conclusion is unimaginatively in the last Section of the paper. The Appendix contains a more detailed description of the data as well as several technical and numerical results regarding the model.

2 The US corporate sector as a net lender

This section documents the key empirical regularities about the capital structure of the U.S. corporate sector both at the aggregate and firm level. The starting point is the aggregate data, drawn from the Financial Accounts (formerly Flow of Funds accounts) of the United States. The focus is on the non-farm, non-financial corporate business sector and on the levels of financial assets, tangible assets, liabilities and net worth during 2000-2007 period.[12]

We compute net financial assets (NFA) as the difference between financial assets and liabilities. A number of recent empirical studies have used cash holdings as a descriptor of firms' savings behavior (see, for instance, Bates et al. (2009), Opler et al. (1999), Boileau and Moyen (2009), Sanchez and Yurdagul (2013) and others) and showed that U.S. firms hold a substantial amount of cash on their balance sheets. Another large strand of literature focused on the liability side of the firms' balance sheets and showed that U.S. corporations remain highly leveraged (see, for instance, Graham et al. (2014), Kalemli-Ozcan et al. (2012) and others).

[10] Other papers that feature endogenous dynamic financing and investment policies include Brennan and Schwartz (1984), Titman and Tsyplakov (2007), and Riddick and Whited (2009).

[11] Other studies that focus on the business cycle properties of external finance include Covas and Den Haan (2011), Bacchetta et al. (2014) and Choe et al. (1993) among others.

[12] All series are converted into real terms using GDP deflator.

Our NFA measure provides a broader perspective on firms' savings behavior by including other types of financial assets in addition to cash. In all cases, the variables are scaled by tangible assets, which provide a measure of the sector's capital stock. All variables are measured at market value.[13]

The first key observation is that the aggregate NFA to capital ratio in the 2000s is *positive*. This is in sharp contrast to the earlier periods: in the 1970s and 1980s the aggregate NFA to capital was relatively stable around -0.15, while in the 1990s it went through a run-up reaching 0.03 in the 2000s.[14] These developments highlight the transition of the U.S. corporate sector from a net debtor into a net creditor at the turn of the century.[15]

Which firms are net lenders? To answer this question we turn to firm-level data from Compustat, focusing on U.S. firms only and excluding technology and financial firms, as well as regulated utilities.[16] Only firms with more than 50,000 USD in capital, non-negative equity, and positive sales are analyzed.[17] This selection leaves us with a sample of 6535 firms in the 2000s. Our measure of net financial assets in the Compustat database is constructed in line with the definitions used in the Financial Accounts. Financial assets are obtained as the sum of cash and short-term investments, total other current assets, and account receivables. Liabilities are computed as the sum of current and long-term debt, accounts payable, and taxes payable. Our measure of tangible assets, or capital, includes firms' gross property, plant and equipment, investment and advances, intangible assets, and inventories.[18]

The gross positions of firms in our dataset line up well with the data facts discussed in the literature. They are presented in Figure 1. Panel (a) of that figure shows median financial assets and their components such as cash and short-term investments, other assets, and account receivables, all as a ratio to median capital. Panel (b) presents median liabilities and their components such as short-term and long-term debt and account payables, also as ratios to median capital. From the figures it is easy to see that median gross assets are rising over time, while median gross liabilities are on a declining trend starting in the early 1980s. Most of the rise in assets is due to higher cash and equivalent holdings of U.S. firms. "Other assets" category has been going up as well, but at a much slower pace. Finally, account receivables have declined from about 28 percent of the median capital level in the 1970s to less than 20 percent in the 2000s.

[FIGURE 1 ABOUT HERE]

On the liability side, long-term debt and account payables have both fallen over time, while short-term debt has shown a slight increase. Overall, these decompositions suggest a shift in firms' balance sheets away from long-term assets and liabilities toward their short-term counterparts, but with the share of account receivables and payables in the short-term assets and liabilities falling over time.

These findings clearly indicate that the rise in corporate savings was not driven entirely by cash and other short-term investments, and instead there have been substantial compositional changes in the gross financial assets and liabilities of the US corporate sector. We view our calculation of the NFA position—netting out the financial asset and debt liability positions—as an useful summary statistic of both the internal savings

[13] The Financial Accounts data set also contains the value of non-financial assets at historical cost. Using these variables does not change the trends in the ratios of NFA to capital but raises their (absolute) levels.

[14] Interestingly, during the 1950s and 1960s, the NFA to capital ratio in the Financial Accounts was above its level in the 1970s and 1980s. However, it remained negative throughout the period, making the qualitative switch of the NFA position in the 2000s unprecedented.

[15] Both aggregate asset and liability positions of the US corporate sector rose over the period, with assets rising faster than liabilities. Unfortunately, the Financial Accounts data provide only a few disaggregated components for both assets and liabilities, preventing us from an in-depth look into the factors behind the rise in aggregate NFA in the U.S. A detailed account of these trends, their various decompositions and robustness checks using both aggregate and firm-level data is available in appendix A.

[16] Technology firms are excluded from our analysis due to a potentially serious mismeasurement of their capital stock, which is predominantly intangible.

[17] When computing statistics that are easily influenced by outliers the top and bottom 1 percent of observations in NFA and capital distributions are dropped.

[18] In terms of the capital-output ratio, our Compustat sample comes very close to matching that ratio in the aggregate economy – the capital-output ratio in our sample is equal to 2 across all industries and is equal to 3 for the largest sector, manufacturing. In terms of overall size, non-financial Compustat firms employ about 36 percent of the aggregate U.S. labor force and hold 60 percent of the aggregate U.S. capital stock during the 2000s. See the appendix A for details.

of the firms as well as the demand or supply of funds to the rest of the economy.[19]

For Compustat firms, mean NFA to capital ratio is positive, very much like in the aggregate data, reaching about 12 percent in 2006-2007 and averaging 7 percent from year 2000. Like in the aggregate data, this ratio was negative at -10 percent during the 1970s.[20]

[FIGURE 2 ABOUT HERE]

Figure 2 plots the distribution of the NFA to capital ratio across firms in the 2000s, while Table 1 reports summary statistics on this distribution. Several features stand out. First, the standard deviation is quite large, equal to 0.65. Second, the distribution of NFA to capital is skewed to the right: the top ten percent of firms in our data set have NFA positions exceeding 138 percent of their tangible assets. However, positive NFA are not confined to a small set of firms, driving the central moments: about 44 percent of all firms in the 2000s have positive NFA positions.[21] Third, the distribution also features a small left-tail, with about ten percent of the firms borrowing more than half their tangible assets.

[TABLE 1 ABOUT HERE]

Are positive NFA positions concentrated within a particular segment of public firms or has the phenomenon been widespread? Looking at NFA positions conditional on firm size, age, industry, and entry cohort, we find that firms in all sectors have experienced an increase in their NFA, with manufacturing firms seeing their net asset positions turn positive in the 2000s. Small to medium size firms, younger firms, and entrants into Compustat contributed the most to the U.S. sector becoming a net lender during the 2000s.[22] Detailed results and discussion of these findings are provided in Appendix A.[23]

Our results indicate that U.S. public firms have been holding significant amounts of internal funds on their balance sheets during the past decade. Why is this noteworthy? Consider a firm's balance sheet which, given the definition of NFA, implies that equity must be equal to NFA plus capital. Thus, positive NFA firms must have equity larger than their capital stock. These large equity positions by positive NFA firms are surprising from the financing cost point of view. Equity carries fiscal cost as both dividends and capital gains are taxed; plus has significant floatation and agency (by bringing external ownership into the company) costs. Thus from a cost perspective the ranking of financing sources is quite straightforward: first, firms should rely on internal funds; if external finance is needed, debt should be preferred to equity. The evidence presented above suggests that firms continue to carry equity even when internal funds are available.

3 The model

The economy is populated by a representative household, entrepreneurs, and the government. Time is discrete and denoted by $t = 0, 1, \ldots$

The entrepreneurs are subject to idiosyncratic shocks and make the core decisions in our model: how

[19] Our focus on NFA was guided by the following considerations: (i) There is significant heterogeneity in firms' gross asset and liability positions, giving us fewer robust data facts to work with for gross position (see appendix A for further discussion); and (ii) for the main mechanisms proposed in the paper there is no need to distinguish between gross asset or liability positions.

[20] The median NFA to capital ratio, has also risen sharply over the past 40 years, although it did not turn positive in the 2000s. An alternative approach is to compute the ratio of mean net savings to mean capital, and the same ratio for medians. The ratio of medians exhibits the same trends as discussed here, while the ratio of means does not exhibit any pronounced trends, suggesting that small and medium-size firms, as opposed to large firms, are behind the rise of net savings in the Compustat data set. These results can be found in Appendix A.

[21] The corresponding number was only 27 percent in the 1970s.

[22] There is an extensive empirical literature that focuses on cross-sectional determinants of corporate leverage (for instance, see Titman and Wessels (1988), Rajan and Zingales (1995), Fama and French (2002), Shyam-Sunder and Myers (1999), and Welch (2004) among others). Our data analysis does not attempt to contribute to this debate, but rather to provide a set of stylized facts on the cross-firm distribution of savings.

[23] Another question is whether firms with foreign operations are responsible for the large positive NFA positions in the 2000s, as these firms may choose not to repatriate their foreign profits for tax reasons and instead keep the funds in their savings accounts. There is no evidence for this hypothesis in the Compustat sample. In fact, NFA to capital ratios of firms with foreign operations, as reported in the income statements, are lower than those for the firms with domestic operations only. Detailed statistics are presented in appendix A.

much to invest and how to finance themselves. Our description of the model accordingly starts with them. The representative household supplies labor and funds to the entrepreneurs, and is used to derive factor and asset prices. Finally the government balance budget constraint closes the model.

3.1 Entrepreneurs

There is a continuum of risk-neutral entrepreneurs, with mass normalized to one. Each period a fraction $\varkappa > 0$ die and an identical measure of new entrepreneurs are born.

3.1.1 Production

Each entrepreneur owns a firm that combines capital k and labor l into final output according to the production function

$$f(l, k; \sigma) = \frac{z(\sigma)^{\nu+\eta} k^{\nu} l^{1-\nu-\eta}}{\nu + \eta}, \tag{1}$$

where $z(\sigma) \in Z$ is an idiosyncratic productivity shock governed by the exogenous state $\sigma \in \Sigma$, which follows a first-order Markov stochastic process. Parameters $\nu, \eta > 0$ satisfy $\nu + \eta < 1$ and determine the income shares of labor, capital, and the entrepreneur's rents.

Labor is hired at a spot market at wage rate w_t. The firm pays a corporate tax rate τ^c on earnings minus capital depreciation expenses, δk_t, where $\delta > 0$ is the depreciation rate of capital. Investment is set one period in advance. In addition we introduce the possibility that a firm suffers a cash flow loss by allowing for additional after-tax expenses $c^f(k_t; \sigma)$. Then, the firm's after-tax net revenues and capital net of depreciation are given by

$$\pi(k; \sigma) = \max_l (1 - \tau^c) \left(f(l, k; \sigma) - wl - \delta k \right) + k - c^f(k; \sigma). \tag{2}$$

The additional expenses may be due to overhead costs, minimum scale requirements, product obsolescence, or, more exceptionally, liabilities or accidents. Operational losses play an important role in our model. Entrepreneurs will periodically have to use finance to cover cash shortfalls, possibly in states of the world where their immediate revenue prospects are poor.

3.1.2 Financing

In order to obtain finance, an entrepreneur may rely on internal funds, debt, or equity issuance. Let a_t denote financial asset position at date t, that is, $a_t > 0$ denotes positive net savings (and thus internal funds), and $a_t < 0$ denotes debt. The pre-tax gross return of savings/debt is $1 + \tilde{r} > 1$. Since interest expenses are deductible from corporate taxes due, the after-tax gross return is $1 + r = 1 + (1 - \tau^c)\tilde{r}$.

Debt is risk-free and hence it must be feasible to repay outstanding debt with probability one. The no-default condition implies the following borrowing constraint:

$$a_{t+1} \geq -\alpha, \tag{3}$$

where α is derived from the primitives of the model, akin to the computation of a natural debt limit for a firm. Appendix B derives the borrowing constraint as well as conditions such that α is strictly positive and independent of the firm's state.

We model equity financing as follows. The entrepreneur can issue claims on the firm's value to the households. The terms on these claims—the shareholder payout policy—are exogenously specified. It is also assumed the entrepreneur retains full control of the firm's decision-making and is the residual claimant of the value of the firm at all times. Let s_{t+1} be the number of equity claims, or shares, issued at date t. At date $t + 1$, after the realization of the firm's state σ_{t+1}, the present value of the shareholder distributions, per claim, is exogenously given by the function $q(k_{t+1}, \sigma_{t+1}) : \Re_+ \times \Sigma \to \Re_+$. Total equity payouts are thus $q(k_{t+1}, \sigma_{t+1})s_{t+1}$. Note all the various forms shareholder payout can take are being subsumed, e.g., dividends, shares buy-backs, capital gains, in the present value of distributions, q. While an exogenous payout policy is less than ideal, our approach is very flexible without compromising the tractability of the model—and it is thus very well suited for quantitative analysis. Finally, entrepreneurs cannot short themselves, $s_{t+1} \geq 0$, and total claims are bounded above, $s_{t+1} \leq 1$.

Investors price shares according to function $p(k_{t+1}, \sigma_t) : \Re_+ \times \Sigma \to \Re_+$. The price schedule will be derived later from the arbitrage condition that leaves the representative household indifferent between holding debt or equity.

3.1.3 The entrepreneur's problem

The entrepreneur is assumed to be in charge of the firm so the entrepreneur's and the firm's problems are equivalent. Financial and productive assets, though, should be viewed as remaining in the firm's balance sheet—otherwise, their fiscal treatment would vary, i.e., factor returns would be subject to the income tax schedule instead of the corporate tax's. Entrepreneurs have risk-neutral preferences and choose plans for asset holdings a_t, capital k_t, equity s_t, and consumption c_t to maximize

$$E_t \left\{ \sum_{j=0}^{\infty} \left(\beta_e(1-\varkappa)\right)^j c_{t+j} \right\}, \tag{4}$$

subject to budget constraint

$$c_t + a_{t+1} + k_{t+1} + q(k_t, \sigma_t)s_t \leq \pi(k_t; \sigma_t) + (1+r)a_t + p(k_{t+1}, \sigma_t)s_{t+1} \tag{5}$$

as well as $c_t \geq 0$, $a_{t+1} \geq -\alpha$, and $s_{t+1} \in [0,1]$ at all dates $t \geq 0$, where $\beta_e \in (0,1)$ is the inter-temporal discount factor of the entrepreneurs.

The entrepreneur's problem can be stated recursively by defining net worth,

$$\omega_{t+1} = \pi(k_{t+1}; \sigma_{t+1}) + (1+r)a_{t+1} - q(k_{t+1}, \sigma_{t+1})s_{t+1}, \tag{6}$$

as the endogenous state variable for the firm's problem. Net worth summarizes all the cash inflows as well as payment obligations of the firm entering in period $t+1$. It is thus a concise summary of the internal funds the firm can tap into. Since cash flow and net financial assets are bounded below, net worth is bounded below, $\omega \geq \omega^b$. There is no upper bound for net worth, and thus the support for net worth is $\Omega = \{\omega \geq \omega^b\}$.

We proceed by splitting the recursive problem into two stages. Given state $\{\omega, \sigma\}$, the entrepreneur decides how much to invest:

$$V(\omega, \sigma) = \max_{k' \in \Gamma(\omega,\sigma)} J(k', \omega, \sigma), \tag{7}$$

where $V : \Omega \times \Sigma \to \Re_+$ is bounded and $\Gamma(\omega, \sigma) : \Omega \times \Sigma \rightrightarrows \Re_+$ is a correspondence with a non-empty compact image.[24] With k' as given, the entrepreneur decides the best way to finance investment, and whether to consume

$$J(k', \omega, \sigma) = \max_{c, a', s'} c + \beta E_\sigma V(\omega'(\sigma'), \sigma') \tag{8}$$

subject to the following constraints

$$\begin{aligned} c + a' + k' &\leq \omega + p(k'; \sigma)s', && (9) \\ c &\geq 0, && (10) \\ a' &\geq -\alpha, && (11) \\ s' &\in [0,1], && (12) \end{aligned}$$

[24] See the Appendix B for a derivation of $\Gamma(\omega, \sigma)$ as well as a detailed discussion of the recursive formulation.

where $\omega'(\sigma') = \pi(k';\sigma') + (1+r)a' - q(k',\sigma')s'$ for all $\sigma' \in \Sigma$. Denote by $\psi^x : \Omega \times \Sigma \to \Re$ the resulting policy functions for $x \in \{c, k', a', s'\}$ and by $\psi^\omega(\omega, \sigma, \sigma')$ the law of motion for net worth.

3.1.4 Entry, exit, and firm distribution

Each period a fraction $\varkappa$ of entrepreneurs exit and an identical measure of entrants replace them. The net worth of exiting entrepreneurs is redistributed among the new entrepreneurs according to the joint distribution $G(\omega, \sigma)$ over net worth and productivity. Entering entrepreneurs must incur a fixed entry cost, f_e, that takes the form of an initial investment necessary to start up production. The entry cost f_e is set such that all new entrepreneurs find it profitable to enter.[25]

Let $F_t(\omega, \sigma)$ be the cumulative distribution function of firms defined over net worth and productivity, with support $\Omega \times \Sigma$. The borrowing constraint indeed ensures that a firm retains positive value at all dates, and thus liquidation is never optimal.

To obtain the law of motion for the firm distribution, the exit and entry dynamics are combined with the law of motion for net worth,

$$F_{t+1}(\omega', \sigma') = \varkappa G(\omega', \sigma') + (1-\varkappa) \sum_{\sigma \in \Sigma} \mu(\sigma'|\sigma) F_t(\phi(\omega', \sigma, \sigma')) \tag{13}$$

for all ω', σ', where $\phi(\omega', \sigma, \sigma') = \sup\{\omega \in \Omega : \psi^\omega(\omega, \sigma, \sigma') \leq \omega'\}$.

3.2 The representative household

The representative household is infinitely-lived and values non-negative consumption c_t^h and labor l_t^h sequences according to

$$\sum_{t=0}^{\infty} \beta^t u\left(c_t^h, l_t^h\right) \tag{14}$$

where u is a utility function with the standard properties and β is the intertemporal discount factor of the household, which is set equal to $\beta_e(1-\varkappa)$, so both the entrepreneur and the representative household have the same effective intertemporal discount factor.

Households earn income from supplying labor as well as from their holdings of the firms' equity and debt. Interest income and shareholder distribution are taxed at effective rates τ^i and τ^e, respectively.[26]

The household budget constraint is thus

$$c_t^h + a_t^h \leq w_t l_t^h + (1 + \tilde{r}(1-\tau^i))a_{t-1}^h + T_t + D_t \tag{15}$$

where $D_t = \int_{\Omega\times\Sigma} \left[s_t^h p_t \left(1 + (1-\tau^e)\left(\frac{q_t}{p_t} - 1\right)\right) - s_{t+1}^h p_{t+1}\right] dF_t$ are the equity payouts from firms, a_t^h are the financial assets held by the household, s_{t+1}^h are the shares held of firms with net worth ω and state σ, and T_t transfers from the government. Explicit references to the state variables are dropped for simplicity of the notation.

The optimality conditions from the household's problem are used to derive the wage as well as the

[25] To be clear, there is no equilibrium condition associated with entry. The rationale for the fixed cost is to close the balance sheet of the firm, by accruing the entrepreneur's rents to the initial investment.

[26] Of course labor income is also taxed. In our model, though, the labor tax rate does not have any implication for the financing decisions of the firms and thus is obviated to economize on notation.

after-tax interest rate:

$$w_t = -\frac{u_t^l}{u_t^c}, \tag{16}$$

$$1 + \tilde{r}(1-\tau^i) = \left(\beta \frac{u_{t+1}^c}{u_t^c}\right)^{-1}. \tag{17}$$

Here u^c and u^l denote marginal utility of consumption and marginal disutility of work, respectively. Finally, there is also a first-order condition for the equity holdings

$$p(k_t(\omega),\sigma) = \left(\beta \frac{u_{t+1}^c}{u_t^c}\right)\left(p(k_t(\omega),\sigma) + (1-\tau^e)\left(E\left\{q(k_{t+1}(\omega),\sigma')|\sigma\right\} - p(k_t(\omega),\sigma)\right)\right). \tag{18}$$

There is no risk premium in the equity price since the representative household is perfectly diversified and there is no aggregate uncertainty.

3.3 Government and stationary equilibrium

Finally, the government collects all tax revenues and rebates them as transfers to the household

$$\tau^c TB_t^c + \tau^e TB_t^e + \tau^i \tilde{r} a_t^h \leq T_t, \tag{19}$$

where the tax base for corporate and equity taxation are given by

$$TR_t^c = \int_{\Omega\times\Sigma} \left(f(l_t(\omega,\sigma), k_t(\omega,\sigma);\sigma) - w_t l_t(\omega,\sigma) - \delta k_t(\omega,\sigma) - r a_{t-1}(\omega,\sigma)\right) dF_t, \tag{20}$$

$$TR_t^e = \int_{\Omega\times\Sigma} s_t^h(\omega,\sigma)\, p\left(k_t(\omega),\sigma\right)\left(\frac{q\left(k_t(\omega),\sigma\right)}{p\left(k_t(\omega),\sigma\right)} - 1\right) dF_t. \tag{21}$$

Tax rates are taken as given by all agents in the economy. The government budget constraint, together with market clearing, ensures aggregate resource constraints are satisfied.

Our focus in this paper is on equilibrium with a stationary distribution of firms, $F_t = F_{t+1}$, and constant aggregate consumption and output.

Definition 1 *A **stationary equilibrium** is a stationary distribution F, prices $\{p, \tilde{r}, w\}$, policy functions $\{\psi^a, \psi^c, \psi^s, \psi^k, \psi^\omega\}$, and household allocations $\{c^h, l^h, a^h, s^h\}$ such that policy functions solve the entrepreneur's problem given prices and taxes, F satisfies the law of motion (13), markets clear, and the household optimality conditions and government budget constraint are satisfied.*

4 Net Savings and Equity

The firm's cost of financing will generally depend on its capital structure, unless interest, equity, and corporate tax rates satisfy a knife-edge condition. The household's optimality condition (18) equates the after-tax returns of equity and debt,

$$1 + (1-\tau^e)\left(\frac{E_t q\left(k_t(\omega),\sigma'\right)}{p\left(k_t(\omega),\sigma\right)} - 1\right) = 1 + \left(1-\tau^i\right)\tilde{r}. \tag{22}$$

This implies that creditors and shareholders do not demand the same *pre-tax* returns, which are the determinants of the cost of financing faced by the firms.[27] Namely, the cost of firms' financing through debt is

[27] The household is perfectly diversified across firms and there is no aggregate uncertainty. As a result, there is no equity risk premium and the expected return is equated across all firms.

$1+\tilde{r}(1-\tau_c)$ or $1+r$, while the cost of financing through equity is

$$\rho^e = \frac{E_t q\left(k_t(\omega), \sigma'\right)}{p\left(k_t(\omega), \sigma\right)}. \tag{23}$$

Since both $(1+r)$ and ρ^e are determined by the household optimality conditions, typically $(1+r) \neq \rho^e$. Define the "markdown" parameter ξ as the wedge in the firms' cost of financing through debt and equity, $\xi = (1+r)/\rho$. The wedge ξ summarizes all the fiscal considerations in the firm's choice for financing. A key property of our model is its ability to generate a demand for financial assets even if debt is fiscally advantageous, $\xi < 1$.

To understand how the model works, let first the entrepreneur tap into as much debt or equity as needed, ignoring the borrowing constraint. Consider first the case with $\xi = 1$. The Miller-Modigliani theorem applies, the entrepreneur is indifferent between financing sources and thus the capital structure of the firm is indeterminate. If $\xi \neq 1$, then the risk-neutral entrepreneur will rely exclusively on the cheaper asset. For our case of interest, equity is relatively costly, $\xi < 1$, and thus the entrepreneur would finance investment exclusively with debt.[28]

Let us now re-introduce the borrowing constraint for the case of costly equity, $\xi < 1$. At first pass this seems of little help to generate a demand for net savings and equity. Debt-holders require a lower return, and the entrepreneur prefers to finance fully with debt. Only if the firm is at debt capacity the entrepreneur would have to resort to equity. In other words, the firm would follow a "pecking order" among finance sources, where internal funds would be preferred to external funds and, among the latter, debt would be preferred to equity. No firm would carry financial assets without retiring as much equity as possible.

However, this argument misses a key observation: the entrepreneur's problem becomes strictly concave due to the interplay between the borrowing constraint and costly equity. Consider a firm following the pecking order described above to finance a given amount of investment. If the firm has a high net worth, investment can be financed at least in part by the firm's own savings, and the borrowing constraint is unlikely to bind. Hence, the firm values an additional dollar of net worth at the risk-free return $1+r$. A firm with low net worth, though, may be at its debt capacity when seeking to finance its investment, and will have to make up the shortfall by issuing equity—increasing its cost of finance. The higher finance cost not only reduces the value of the firm, but it also increases the value of additional net worth: now one dollar allows the firm to save the expected return to equity, $(1+r)/\xi$. Hence, the firm values a dollar more when it has low net worth than when it has high net worth, resulting in a concave value function. Indeed, the differences in the marginal value of net worth become much larger once the full dynamic program is considered.[29]

Given that the firm's value function is concave, firms will strive to accumulate net financial assets for precautionary reasons in presence of uncertainty.[30] That is, firms want to build their net worth up rapidly in order to decrease the probability that they find themselves at debt capacity at future dates. Indeed, the entrepreneur delays any distributions to herself until the firm can self-finance at all future dates.[31]

Firms will also be willing to pay a premium for equity if dividend distributions and net worth are positively correlated—and such premium is needed to generate a positive demand for equity given that equity is at a fiscal disadvantage, $\xi < 1$. In fact, firms will fund additional financial asset holdings with equity revenues. Consider the first-order condition associated with positive equity issuance, written in terms of the covariance (Cov),

$$p(k', \sigma)\lambda = \beta E\left\{V'\left(\omega'(\sigma'), \sigma'\right)\right\} E\left\{q(k', \sigma')\right\} + \beta \mathrm{Cov}\left(V'\left(\omega'(\sigma'), \sigma'\right), q(k', \sigma')\right), \tag{24}$$

where λ is the Lagrangian multiplier associated with the firm's budget constraint and arguments have been

[28] If $\xi > 1$, then the return on equity is lower than the return on debt (and thus savings). The entrepreneur would engage in arbitrage in this case: she would raise as much funds as possible from shareholders and simply save the proceeds.

[29] We are, perhaps, only heeding the point emphasized by Hennessy and Whited (2005) that it is essential to view the capital structure decision in the context of a fully specified dynamic problem.

[30] The precautionary motive here resembles closely the one found in models of household finance. See, for instance, Carroll (1997), Gourinchas and Parker (2002) and Fuchs-Schundeln (2008).

[31] The finite support for shocks implies that there exists a level of financial assets, a^*, such that the net return ra^* is sufficient to cover all finance needs in all states. Thus the entrepreneur can maintain the financial asset position a^* with probability one and consume the excess cash flow.

dropped whenever there is no confusion possible. Now assume that the firm is not at debt capacity, $a > -\alpha$, and thus the last dollar of equity revenues is effectively funding the financial assets of the firm. Using the wedge ξ and dividing through by $p(k', \sigma)$,

$$\lambda - \beta E\left\{V'\left(\omega'(\sigma'), \sigma'\right)\right\} E\left\{\frac{q(k', \sigma')}{p(k', \sigma)}\right\} = \lambda - \xi^{-1}\beta(1+r)E\left\{V'\left(\omega'(\sigma'), \sigma'\right)\right\} < 0, \tag{25}$$

where the last inequality is signed by using the first-order condition associated with the entrepreneur's consumption. Clearly, both equity and debt optimality conditions can be satisfied simultaneously only if $\mathrm{Cov}\left(V'\left(\omega'(\sigma'), \sigma'\right), \frac{q(k',\sigma')}{p(k',\sigma)}\right) < 0$. This requires both that the value function V is strictly concave, and shareholder payouts are positively correlated with net worth. As discussed earlier, the concavity arises naturally due to the interplay between the borrowing constraint and the cost of equity. The positive correlation of equity payouts with net worth will result from the positive correlation of dividends with cash flow. Since shareholders payouts decrease when the firm has low cash flow or losses, equity delivers some financial relief to the entrepreneur exactly in the states where the firm will have lower net worth and thus is likely to face a higher finance cost. As a result, entrepreneurs are willing to pay an additional cost for equity—akin to an insurance premium.

It perhaps remains counter-intuitive that firms issue equity, at a cost, to insure themselves against the cost of equity financing in future periods. The key is that an additional dollar for a firm with low net worth allows the firm to reduce equity reliance in the present *and future periods*. Note that a firm with low net worth has no choice but to commit a large share of its future cash flow to shareholder distributions. There is thus nothing but a trickle for the firm to crawl out from the borrowing constraint, building its net worth very slowly and resorting to equity repeatedly. One more dollar of net worth allows the firm to reduce equity issuance in the present period, which in turn frees additional cash flow in the next period and again reduces equity outstanding in that period, and so on. This intuition is illustrated further by means of a simple example in Appendix C.

5 Calibration

Can our model replicate the cross-firm distribution of NFA and generate positive aggregate NFA as observed for the period 2000-2007? As the model is taken to the task, there are two crucial aspects of the calibration. First, the fiscal cost of equity relative to debt needs to be quantified. Second, we have to decide which moments to target with the productivity process. The remaining parameters regarding technology and entry are set to standard or straightforward values.

The fiscal cost of equity. In Section 3 there is a single "effective" tax rate on all shareholder distributions but the actual U.S. tax code is far from being that simple. Fortunately, it is quite straightforward to map a more nuanced view of equity taxation into the relative cost of equity, ξ. Appendix B derives the equity price households demand such that the after-tax return of debt and equity is equated accounting for dividend, capital-gains, and interest-income tax rates, denoted τ^d, τ^g, and τ^i, respectively. The resulting markdown is

$$\xi = \frac{(1-\tau^d)\left((1-\tau^c)\tilde{R} - \gamma_a\right)}{(1-\tau^i)\tilde{R} - (1-\tau^g)\gamma_a}, \tag{26}$$

where γ_a is the growth rate of the equity price, and $\tilde{R}$ is the interest rate on corporate debt, both in nominal terms. While the inflation rate does not enter the expression explicitly, both the nominal interest rate and the asset price growth rate vary with inflation.

We use tax and interest rates for the period 2000-2007 for the U.S. and rely both on statutory rates and estimates from the public finance literature. Our choices are summarized in Table 2. Detailed discussion of these values is included in Appendix D. In addition, the inflation rate is set at 2 percent, which gives an after-tax real rate of 2.5 percent.

[TABLE 2 ABOUT HERE]

Shareholder payouts. We assume that the present value of shareholder payout, q, is proportional to the firm's cash flow and capital holdings, $\pi(k_{t+1};\sigma_{t+1})$:

$$q(k_{t+1},\sigma_{t+1}) = \frac{1}{1-\beta}\pi(k_{t+1};\sigma_{t+1}). \tag{27}$$

While admittedly ad-hoc, our specification aims to be a parsimonious representation of the shareholder payout policies observed in the data.[32] In our Compustat data, total payout is strongly positively correlated with contemporaneous firm's cash flow (correlation coefficient of 0.67) and tangible assets (correlation coefficient of 0.55).[33] The positive association between firm's performance and its shareholder payouts is also backed by a long literature (see, for instance, Lintner (1956), Fama and Babiak (1968), Fama and French (2001), Denis and Osobov (2008), Skinner (2008)).

The positive comovement between the firm's performance and shareholder payout is also important from the model standpoint. As discussed in Section 4 this is the key property that makes equity valuable to the firm.[34]

Technology, preferences, and entry parameters. The technology parameters are calibrated as follows. The coefficient $\eta = .12$ to equate the entrepreneurs' rents to the share of dividends over GDP. Parameter ν is set to .2. Assuming entrepreneur rents are split 50-50 between capital and labor income accounts, this results in the standard total capital income share of 36 percent. The depreciation rate is set to 6 percent.

Household preferences are given by $u(c - h(l))$ such that the labor supply is given simply by $h'(l) = w$. This implies that the computation of the stationary equilibrium does not require specifying u and h, and the wage rate can be normalized to 1 without any loss of generality. The discount rate β is pinned down by our earlier choice of the interest rate. The resulting value .96 is standard.

The exit/entry parameter is set at 5 percent, closer to the exit rate in the Compustat data. The net worth distribution of entrants is given by a Pareto distribution with curvature parameter ς equal to 1.3, which matches the relative capital holdings of entrants to incumbents. The entry cost f_e is set to match the 10th percentile of the distribution of NFA over capital.[35] Table 3 summarizes our parameter choices.

[TABLE 3 ABOUT HERE]

Productivity process. In calibrating productivity process, our primary objective is to match the firms' observed financing needs. In the data, we identify two key drivers of these needs: negative cash flows and large investment expenses in excess of the firms' contemporaneous cash flows.

First, about 25% of the firms in our sample had a negative cash flow, defined as operating income before depreciation expenses, in any given year during the 2000-2007 period. The transition rate from positive to negative cash flow is also quite high at 6%. Firms must balance the operating loss with either a decrease in assets or an increase in liabilities. In particular, cash flow shortfalls will provide a strong basis for the precautionary demand for financial assets.[36]

[32] The value of the constant of proportionality between payouts and π is irrelevant. Recall that q is the present value per share, and thus any scaling of q simply results in a change of units for shares. Our choice simply renders shares comparable to infinitely-lived assets.

[33] Shareholder distributions are computed as the sum of common dividends and equity repurchases. The latter is obtained as the total expenditure on the purchase of common and preferred stocks minus any reduction in the value of preferred stocks outstanding. Observations with negative preferred shock redemption value and with negative values for the purchase of common or preferred stock are excluded. This definition is borrowed from Grullon and Michaely (2002) and is very close to that used in Jagannathan et al. (2000) who also included preferred stocks in their measure of the repurchase activity.

[34] The precautionary motive would remain even if we had specified equity as a full state-contingent contract; firms would still tolerate some residual risk because of the additional cost of equity $\xi < 1$. In our specification the linear relationship with cash flows further limits the insurance properties of equity.

[35] Parameters ς and f_e are matched to moments that require us to evaluate the full model, and thus it would be more correct to say that they are jointly calibrated with the productivity process. However the relationship between the parameters and the moments is very tight, so we feel comfortable linking them at this point.

[36] Lins et al. (2010) document that CFOs use cash to guard against future negative cash flow shocks. Lines of credit, due to financial covenants, are not a good substitute, as documented by Sufi (2009). Our operational losses are akin to liquidity

Second, firms occasionally have opportunities to expand their operations. These opportunities often present themselves without any relationship to the contemporaneous cash flow of the firm and usually require investment expenditures that are larger than the firm's net revenues. For the period 2000-2007, about 22% of the firms with positive cash flow incurred investment expenditures in excess of their cash flow in a given year. Among those, more than half had investment expenditures totaling 150% or more of their cash flow. Firms that want to take advantage of these opportunities need to finance their increase in assets without having the benefit of an immediate increase in cash flows.[37]

We propose a productivity process that directly incorporates these features of the data. More precisely, productivity is modeled as a ladder where investment opportunity shocks lead a firm to move up the ladder, while operational losses lead a firm to drop off the ladder. Productivity takes one of n levels, $\{z_1, z_2, \ldots, z_n\}$. Operational losses are given by state $n = 1$, setting $z_1 = 0$, so for simplicity there are zero net revenues in that state, and cost expenses $c^f(k, z_1)$ are such that equation (2) becomes $\pi(k, z_1) = 0$ for all k. Note that this still implies that a firm experiencing operational loss has a negative cash flow. For simplicity, $c^f(z, k) = 0$ for all other states and levels of investment, thus ensuring that net revenues are non-negative everywhere but in state 1. The probability of operational losses for a firm with productivity level z is denoted by $\phi(z) > 0$. Note that our specification for operational losses implies that the no-default borrowing constraint is constant across firms, as it suffices to show that the firm can repay the outstanding debt in the event of operational losses.

Investment opportunities are modeled as a step up the productivity ladder. A firm with productivity level z has a probability $\iota(z)$ to receive an investment opportunity shock. Such a firm will then either transition to operational losses (with probability $\phi(z)$) or will upgrade their productivity by one level. That is, a firm with productivity level $z_t = z_i$ that receives an investment opportunity will transition to productivity level $z_{t+1} = z_{i+1}$ next period with probability $1 - \phi(z_i)$, or $z_{t+1} = z_1$ with probability $\phi(z_i)$. A firm without an investment opportunity remains at the same productivity level, $z_{t+1} = z_i$ next period with probability $1 - \phi(z_i)$, or $z_{t+1} = z_1$ with probability $\phi(z_i)$.[38]

Finally, productivity levels $z_2, z_3, \ldots, z_n$ are equally log-spaced, with growth rate γ_z, that is, $z_i = \gamma_z^{i-2} z_2$. This guarantees that there is no hard-wired relationship between firm size and growth rates.

In order to discipline the transition probabilities $\phi(z_i), \iota(z_i) : i = 1, \ldots, n$ we match the age profiles for operational losses and investment opportunities observed in the data.[39] Table 4 reports the transition probabilities governing the productivity process. It is important to note that the calibration also matches the unconditional transition probability into operational losses, 6%, and the share of firms with investment expenditures exceeding their cash flow, 22%.[40]

Finally, the growth rate of productivity along the ladder, γ_z, is set to reproduce an average growth rate in revenues of about 5% among firms with positive cash flow. The level z_2 is normalized to 1. Nine states are used for the productivity process, enough to generate a right tail in revenues, yet keep the computational time in check.[41]

[TABLE 4 ABOUT HERE]

Lastly, we would like to emphasize that since the targeted facts are for publicly traded firms, only the firms in our model that have a positive probability of issuing equity are considered. In the model firms with very high net worth can rely exclusively on self-financing for investment—and thus have no need to tap

shocks in Boileau and Moyen (2009), with the exception that Boileau and Moyen (2009) model liquidity shocks as stochastic expenses faced by firms, while the frequency of negative cash flows is our measure of liquidity shocks.

[37]Under the usual autoregressive productivity process, financing needs arise only when the firm is experiencing a cash-flow windfall. Thus, it is quite easy for firms to self-finance.

[38]Firms at state z_1 automatically have an investment opportunity, so they transition to z_2 unless they suffer operational losses again. Firms with the highest productivity level, z_n, do not receive further investment opportunities.

[39]Appendix D displays these probabilities in the data and in the model.

[40]Because investment is an endogenous variable in the model, the probability ι_i does not need to coincide exactly with the share of firms with investment expenditures in excess of their cash flow in the model. However, the difference between the two is very small.

[41]Our interest in firms' financing choices necessitates the use of cash flows, as opposed to revenues or value added, when calibrating the productivity process. In any case, Section 6 shows that with our calibration the model generates the distribution of revenues that is very close to the data and is broadly consistent with Midrigan and Xu (2014).

outside investors. These firms are viewed to be private equity and are dropped from our sample.[42]

6 Results

This section presents our numerical results for the joint distribution of NFA and firms' characteristics.

6.1 Net financial assets

Does our model replicate the distribution and positive aggregate level of NFA observed during 2000-2007? Yes, it does. Table 5 reports the model predictions along with the corresponding data moments. Our model reproduces the large fraction of firms with a positive NFA position, 43.5% in the data versus 41.8% in the model. The model's performance regarding the central moments is also very good. The mean NFA to capital is just a tad below the data, and the median is matched exactly.[43]

[TABLE 5 ABOUT HERE]

The model does a remarkable job at matching the full distribution of NFA over K in the data. The standard deviation in the model and in the data is very close, so we are confident that our simple productivity process is capable of generating enough variation in corporate finance portfolios. Both the first and third quartiles are very close to the data.[44] There is some overshooting of the 90th percentile, albeit not by a large margin.

[FIGURE 3 ABOUT HERE]

Figure 3 presents the histogram of the NFA to capital as generated by the model. As in the data, the distribution is skewed to the right and features a long right tail, with a small number of firms having very large NFA holdings relative to their productive assets. The model generates a left tail as well, albeit slightly shorter than in the data where a small fraction of firms are observed to have negative NFA positions in excess of 70% of their assets. In the model, all firms share the same debt limit, which limits our ability to generate enough dispersion among firms that rely heavily on debt.

Our model can rationalize the corporate sector as a net lender only through the mechanism highlighted in Section 4. No productivity process would generate positive NFA if taxes were equated across debt and equity or the borrowing constraint was dropped. If equity had no fiscal costs, all firms would spurn debt. At the same time, with the fiscal cost of equity but without a borrowing constraint, all firms would finance only with debt, as it is the cheaper finance source. Finally, without equity payouts providing partial insurance, no firms with positive NFA actively relying on equity would be observed.

Quantitatively, though, our specification for productivity is key to the model's fit. The fact that the model performs very well suggests that operational losses and investment opportunities effectively capture the relevant shocks for firms' financing structure and that the link between financing needs and balance sheets is very tight.

6.2 Other firm characteristics

The next step is to check how the model performs regarding variables other than NFA. Since our process for productivity is admittedly non-standard, it is important to check the model's predictions for variables that are typically used in the literature to calibrate the productivity process, such as employment, revenues, and investment.

[42]Note the model's sample includes all firms with debt. Thus the censoring from the model does not help to generate positive NFA in the sample. The fraction of firms dropped is usually very small, less than 5 percent.

[43]Moments are computed from a simulation of 50,000 firms drawn from the stationary distribution. To ensure consistency the simulated data is treated as the data was in Section 2.

[44]Recall the fixed entry parameter f_e is set to target the 10th percentile, although this has surprisingly little effect on the overall shape of the distribution.

Table 6 reports various unconditional moments for investment and revenues in the model and data: the mean of a given variable relative to the mean capital; the same for standard deviations; and the autoregressive coefficients.

Model's overall performance is very satisfactory. The model matches closely the first and second moments for investment and revenues. Perhaps the only noticeable difference is that investment is, on average, a bit higher than in the data as well as slightly less persistent. We are comfortable with the small gap on both counts since there are some reasons to think that investment and capital may be understated in the data compared with the model.[45]

[TABLE 6 ABOUT HERE]

The model's performance extends to employment and cash flows, since both variables are very closely tied to the firm's revenues both in the data and in the model. The model closely matches the standard deviation of log employment, 1.25 in the data versus 1.24 in the model, and is virtually spot on the auto-correlation coefficient for employment. This gives confidence that our process, despite its simplicity, is capturing the dispersion in size in the data. Regarding cash flows, the model slightly overstates the persistence in cash flows, 0.87 in the data versus 0.95 in the model, suggesting that there is some stochastic variation in expenses that the model may be missing.[46]

Given their key role in our calibration, we also check how operational losses vary across several firm's characteristics. The model tracks closely the decreasing relationship with capital, total assets, revenues and employment.[47]

Lastly, the predictions of the model for the shareholder's payout are compared with the data. These are summarized in Table 7. The mean payouts in the data are small at about 4% annually as a share of mean capital, not very volatile at 6% relative to capital and quite persistent (with autocorrelation coefficient of 0.73). The model's predictions are quite close to these numbers.

How do shareholder distributions correlate with firms' characteristics? In the model we posit that the shareholder payout is proportional to the firm's cash flow and capital holdings, $\pi(k_{t+1};\sigma_{t+1})$, a relationship strongly motivated by the data. Not surprisingly, the model predicts large positive correlations of payout with capital (equal to 0.89) and cash flows (equal to 0.92), with the comovement being stronger with cash flow as in the data. In the model shareholder payout are also strongly positively correlated with revenues and book equity, both of which are in close correspondence with the data.[48]

[TABLE 7 ABOUT HERE]

6.3 Which firms have positive net savings?

Does the model predict the right *joint* distribution of NFA and key variables, such as investment, equity, and revenues? To answer this question the model's predictions *conditional* on NFA are compared with the data.

Let us start with a quick look at the model predictions. Figure 4 plots the policy functions for NFA and capital, as function of net worth, for a firm in state z_4 without an investment opportunity (solid lines marked No inv.opp.).[49] Book equity and the ratio of NFA to capital are also included.

[FIGURE 4 ABOUT HERE]

Firms with low net worth are net borrowers and their investment is low. As a result, these firms also

[45] First, firms may be renting equipment and machinery, so structures are disproportionately represented in the category of tangible assets. Second, bookkeeping rules for investment and capital do not always correspond to their economic counterparts and are sometimes shaped by fiscal considerations of their own—most notoriously in the treatment of depreciation.

[46] The model is spot on regarding revenues, so expenses are likely to explain the lower auto-correlation coefficient in the data.

[47] These results are presented in more detail in Appendix E.

[48] Equity in the model is given by the book value (BE) from the firm's balance sheet. This corresponds the closest to book equity measure in the Compustat's balance sheet statements. It is equal to the total stockholders' equity.

[49] State z_4 roughly corresponds to the median productivity in the model. All the policy functions are qualitatively very similar across states. Only the lower half of the support for net worth is displayed, where most firms lay.

have low book equity and revenues (not shown). Their smaller scale reflects their higher cost of external finance. As firms build their net worth, they increase both capital and NFA roughly at the same pace, and eventually become net savers. The latter clearly have more capital and book equity, and thus more revenue. Since both NFA and capital are increasing as a function of net worth, it is an open question whether NFA to capital increases with net worth. The lower-right plot displays the ratio of NFA to capital, which is clearly increasing and turns positive for sufficiently high levels of net worth. Summarizing, the model predicts that higher-NFA firms have higher revenues, investment, and book equity.

Figure 4 also plots the policy functions of a firm in the same productivity state z_4 but with an investment opportunity available (dashed lines marked Inv.opp.). This allows us to see how firms adjust their positions, and how this adjustment is different depending on whether the firm has enough net worth to have accumulated net savings or not. Not surprisingly, firms react to an investment opportunity by increasing investment, drawing from their net savings or borrowing, and possibly raising some additional equity. Note how firms with low and high net worth differ in their capacity to take advantage of the investment opportunity. Firms with high net worth are capable of boosting their investment further as they have more spare borrowing capacity or even net savings available. This translates into higher revenue growth rates for firms with positive net savings. The latter also build their net worth much faster, which translates into higher equity growth as well.

Table 8 compares the quantitative predictions of the model with the data by reporting the ratio of means of investment, revenues, book equity and annual changes in book equity, for firms with positive and non-positive NFA. The positive NFA firm invest more than non-positive NFA firms, in the order of 28% on average. The model is almost spot on in matching the difference. Firms with positive net savings are also more valuable and collect higher revenues in the model as well as in the data. The model, though, tends to understate the differences in book equity values. Firms with positive NFA also see their equity increase at a more rapid pace. As discussed before, investment opportunity shocks are key in the model to generate these differences. That said, operational losses and the inherent non-linearities of the law of motion for net worth also contribute to the disparity in equity adjustments.

[TABLE 8 ABOUT HERE]

Overall, we view these findings as strong evidence that our parsimonious model captures well the key determinants of NFA positions in the data.

7 Corporate net savings in the 1970s

The corporate sector was a net debtor in the 1970s, with much fewer firms holding positive NFA positions, as reported in Section 2. Two possible causes are explored in this Section. First, statutory dividend tax rates in the 1970s were substantially higher: Since our model has emphasized the importance of capital income taxation for firms' savings decision, the time-variation in the fiscal burden on equity provides us with an opportunity to explore the quantitative predictions of the model's main mechanism. Second, several researchers have documented an increase in the idiosyncratic risk for firms in the 1990s and 2000s, and some work have linked such development to the increase in the firms' cash holdings.[50] Indeed, firms in our data set exhibit lower risk in the 1970s through a lower probability of experiencing operational losses.

We do not aim to provide an exhaustive account of all changes behind the shift in NFA holdings between the 1970s and the 2000s. The model is simply not equipped to explore all the hypotheses that have been put forth: secular changes in the cost of investment, intangible assets, product market competition, cost of innovation, switch to just-in-time inventory system, among others.[51]

[50] See Bates et al. (2009), Boileau and Moyen (2009) and, more recently, Zhao (2015) and Bates et al. (forthcoming).

[51] See, respectively, Karabarbounis and Neiman (2012); Falato et al. (2013); Morellec et al. (2013) and Della Seta (2013); Ma et al. (2014) and Lyandres and Palazzo (2011); and Gao (forthcoming).

7.1 Dividend taxes

There have been two main forces easing the fiscal burden on equity over the past 40 years. First, there were significant cuts in the top marginal income tax rates in the 1980s and, starting in 2003, dividend income was taxed separately from income and at a rate significantly below income tax rates.[52] The second force has been emphasized by McGrattan and Prescott (2005), who argue that changes in regulation have had an important impact on the effective marginal tax rates by increasing the share of equity held by fiduciary institutions that pay no taxes on dividend income (or capital gains).[53]

We rely on Poterba (1987) for effective tax rate estimates and set the dividend tax rate τ^d corresponding to the 1970s at 0.28. Our baseline calibration for the 2000s used a tax rate of $\tau^d = 0.15$, the statutory rate for most of the period. There is no statutory rate for the 1970s, since dividend income was not taxed separately. The effective tax rate is instead estimated from marginal income tax rates and the distribution of income across households.[54] Thus according to our calculations, the decline in dividend taxation during the 1980s and 1990s, up to the Jobs and Growth Tax Relief Reconciliation Act of 2003, halved the effective dividend tax rate. The markdown parameter for the 1970s is recomputed with the higher tax rate, which renders equity more expensive relative to debt, $\xi = 0.69$. The estimates for the effective dividend tax in the 1970s from McGrattan and Prescott (2005) are even higher.

All the remaining parameters of the model are kept unchanged.[55] Tax rates on capital gains have also been estimated to be slightly higher in the 1970s.[56] However, the effect on the relative cost of equity to debt is quite small, and we feel comfortable focusing on dividend taxes. A more important omission is the higher statutory corporate tax rate observed in the 1970s, on the vicinity of 46% compared with 34% in the 2000s. However, changing corporate tax rate in our model requires a concurrent adjustment in the intertemporal discount factor β, and thus confounds the effects of both factors. A detailed discussion of this issue and some exercises with the higher corporate tax rate are provided in the Appendix E.

Table 9 reports the moments from the distribution of NFA to capital from the model evaluated at $\tau^d = 0.28$ and compares them with the data. The shift toward debt in the model is remarkably close to the data. The model predicts the mean NFA to capital in the 1970s at -0.06 while the corresponding number in the data is -0.12. Roughly speaking, the model captures a bit more than two thirds of the dramatic drop in the average NFA position relative to the 2000s. The model is actually getting most of the shift in the distribution right, with the median in the data and the model being very close. Similarly, just above 32% of the firms in the model have a positive NFA in the 1970s, down from the 42% in the 2000s, and very close to the 27% in the data in the 1970s.

[TABLE 9 ABOUT HERE]

For such a stark exercise as ours, the overall fit of the distribution is surprisingly good across all percentiles but the top ones. Indeed, it is the very top 10 percent of firms in the NFA to K distribution that are responsible for most of the differences between model and data: the observed standard deviation for the 1970s is significantly lower than predicted by the model, and the average NFA to K ratio is higher in the model than in the data.

What are the implications of the higher dividend tax rates for the capital-to-output ratio, and thus investment? The model predicts the capital-to-output ratio in the 1970s to be slightly below its value in the 2000s of 2.7% to be precise.[57] The cost of capital increases with the dividend tax rate, as one would expect, but the response is quite muted.

[52] The public finance literature has documented this shift extensively as early as in Poterba (1987). The latter change was brought up by the Jobs and Growth Tax Relief Reconciliation Act of 2003, which spurred a large literature.

[53] See Rydqvist et al. (2011) for cross-country evidence on the role of tax policies on the decline of direct stock ownership by households.

[54] See Poterba (2002) for further details and an updated time series.

[55] For the exercise, the borrowing constraint is treated as a parameter. As the support for the net worth distribution changes, the entry distribution is adjusted to replicate the entrants' characteristics in the 2000s.

[56] See Poterba (2002).

[57] This is in line with the U.S. data, where the capital-to-output ratio in the data has been broadly stable in the last 40 years. However, our model can offer only an incomplete picture of the growth experience of the U.S. as we lack an explicit formulation for intangible investment. See McGrattan and Prescott (2005).

It is perhaps not surprising that a higher dividend tax rate increases the cost of capital and thus decreases investment, but the sharp response of net savings and the mild response of investment deserve further discussion. Clearly, everything else equal, the more expensive equity is, the more firms rely on debt to finance investment. The shift toward debt is magnified by the fact that now it takes longer for firms to build up internal funds and thus, on average, they have to rely more on external finance. Therefore, NFA positions in the model decline substantially. The large shift toward debt in the firms' balance sheet also implies that firms are able to insulate the cost of capital from the increase in the cost of equity, thus leaving investment relatively unchanged.

7.2 Idiosyncratic firm risk

Several studies have argued that the idiosyncratic risk for firms has increased over the last few decades.[58] In our data set firms exhibit a substantially lower risk profile in the 1970s, driven by a lower frequency of operational losses. The share of firms with operating losses in the 1970s is 7.4%, about one third of that in the 2000s; and the probability a firm with positive net revenues transitions to a net loss roughly halved, to 3.8%. In contrast, there are no systematic differences in the profile for investment opportunities—the other factor driving our productivity process. Appendix E reports the profiles and documents the data construction.

In order to capture the lower idiosyncratic risk in the 1970s we recalibrate the productivity process. The steps are the same as for the baseline calibration documented in Section 5, but now targeting the age profiles in the 1970s (see Appendix E). Given that there are no substantial differences in the profile for investment opportunities, only the parameters for the operational losses are adjusted. The remaining parameters are set to their baseline values but for the dividend tax rate, which is set to 28%.

Table 10 reports the new values for the probability of an operational loss for each state, ϕ_i. Not surprisingly, they are substantially lower than in the baseline calibration.

[TABLE 10 ABOUT HERE]

Table 11 reports the results of the simulation (last column) using the recalibrated productivity process together with a dividend tax rate of 28%. For comparison, the results of the baseline calibration for the 2000s as well as the exercise with only a higher dividend tax rate are included. The first column reports the data counterparts to the key moments.

[TABLE 11 ABOUT HERE]

The results are certainly remarkable: The new calibration closes the gap regarding average NFA/K between the 1970s and 2000s, reducing the model's prediction with only the dividend tax adjustment by five percentage points to $-.11$, pretty much spot on with the observed average NFA/K ratio of $-.12$. In short, firms are now comfortable holding large amounts of debt, no longer rushing to build up a large NFA position for precautionary motives and taking full advantage of the favorable fiscal treatment of debt.

At the same time, the fit of the new calibration is not perfect. The share of firms with positive NFA remains a bit too high, and so does the median NFA/K. The bottom quartile of firms by NFA position have too much debt, as it can be seen from the 10th and 25th percentiles. However, the new calibration does quite a bit to reduce the excessively thick right tail that the calibration with only higher dividend taxes had.

[58] Comin and Philippon (2005) and Irvine and Pontiff (2009) document how volatility of sales, cash flows, and employment growth for Compustat firms has sharply increased. Campbell et al. (2001) also report similar increases in the volatility of firm-level returns. These findings, however, are not free of contention: Davis et al. (2006) argue that privately-held firms display the opposite behavior. See also Thesmar and Thoenig (2011). In addition, the increased risk has been previously linked to the rise in corporate assets, in Boileau and Moyen (2009) and Bates et al. (forthcoming), among others.

8 Conclusions

The U.S. corporate sector and publicly-traded firms have accumulated positive net financial position in the last decade. To explain this fact we develop a model capable of generating simultaneous demand for equity and net savings, despite the fiscal advantages associated with debt. Our hypothesis emphasizes the risk considerations firms face in their capital structure decisions. In particular, demand for net savings is driven by a precautionary motive as firms seek to avoid being financially constrained in future periods. Simultaneously, firms value equity as it provides partial insurance against investment risk. The model can match quantitatively the net lender position of the corporate sector for the period of 2000-2007 and replicates the overall distribution of NFA during that period very well.

Going forward, the model can provide the groundwork to study a number of questions. First, we would like to set the changes in the saving behavior of the corporate sector in the broader context of the whole economy. For example, the rise of corporate net savings broadly coincides with a fall in the personal savings rate for U.S. households. How are these phenomena related? What are the implications for aggregate savings and investment? Second, an exhaustive, in-depth exploration of the forces behind an increase in corporate savings over the past 40 years is still lacking. How do the different mechanisms provided in the literature compare, and do they stack with each other?

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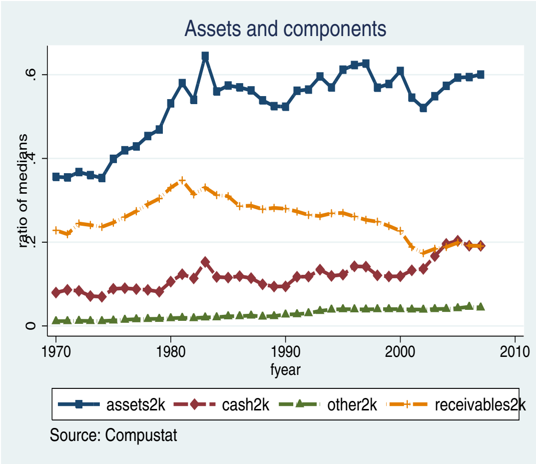
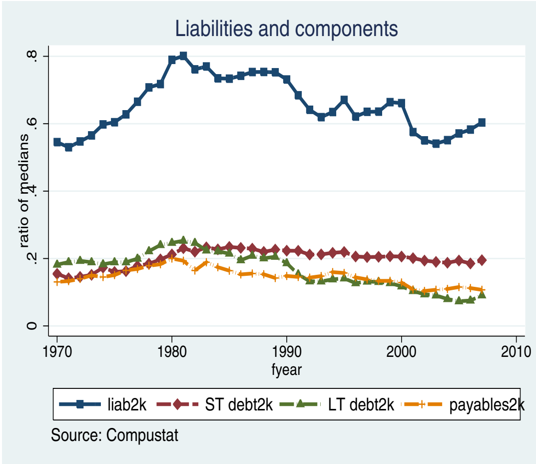
867 # Tables and figures

Figure 1: Gross positions and their components



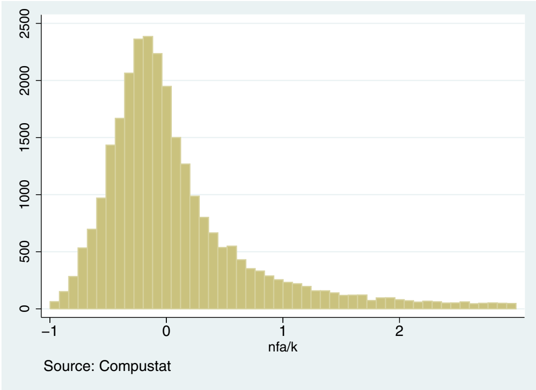
(a) Assets



(b) Liabilities

Note: This figure plots gross asset and liability positions and their components of the US corporate sector in the Compustat sample during the 2000-2007 period.

Figure 2: NFA/capital density, 2000s



Note: This figure plots the density of net financial assets (NFA) to capital ratio for the US corporate sector in the Compustat sample during the 2000-2007 period.

Table 1: Moments of corporate NFA/capital distribution

NFA/K	2000s
mean	0.07
median	-0.07
Pr(NFA>0)	43.5
skeweness	1.81
std dev	0.65
10pct	-0.51
25pct	-0.31
75pct	0.35
90pct	1.38

Note: This table presents various moments for the distribution of the net financial assets (NFA) to capital ratio for the US corporate sector in the Compustat sample during the 2000-2007 period. Pr refers to probability, pct refers to percentile.

Table 2: Taxes and interest rate — Baseline calibration

	Parameter	Value
Corporate tax	τ^c	0.34
Dividend tax	τ^d	0.15
Interest income tax	τ^i	0.34
Capital gains tax	τ^g	0.15
Pre-tax nominal interest rate	$\tilde{R}$	0.07
Equity markdown	ξ	0.82

Note: This table presents the values for tax rates and interest rates used in the baseline model calibration.

Table 3: Technology and entry parameters — Baseline calibration

	Parameter	Value
Discount factor	β	0.96
Entrepreneur rent	η	0.12
Depreciation rate	δ	0.06
Capital elasticity	υ	0.20
Exit rate	$\varkappa$	0.05
Entry distribution	ς	1.3
Entry cost	f_e	4.28

Note: This table presents the values for preference, technology and entry parameters used in the baseline model calibration.

Table 4: Productivity process — Baseline calibration

	State i								
	1	2	3	4	5	6	7	8	9
Operational loss ϕ_i	.13	.12	.04	.04	.04	.035	.035	.035	.03
Investment opportunity ι_i	1	.3	.25	.2	.2	.18	.15	.1	0

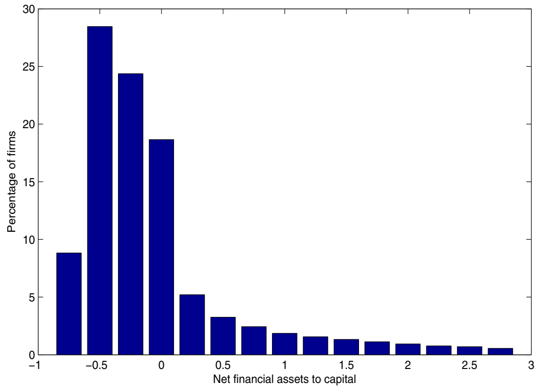
Note: This table presents the probabilities of transitioning into operational losses, ϕ_i, from productivity state i, and receiving an investment opportunity, ι_i, when in productivity state i, used in the baseline model calibration.

Table 5: Model and Data - Net financial assets to Capital

	2000s	
	Data	Model
mean	0.07	0.06
median	-0.07	-0.07
Pr($NFA > 0$)	43.5%	41.8%
std dev	0.65	0.67
10pct	-0.51	-0.51
25pct	-0.31	-0.39
75pct	0.35	0.23
90pct	1.38	1.65

Note: This table contrasts the moments of net financial assets (NFA) to capital distribution in the data (Compustat sample, 2000-2007 period) with those obtained from the model under the baseline calibration. Pr refers to probability, pct refers to percentile.

Figure 3: NFA to capital histogram, model



Note: This figure plots the histogram of net financial assets (NFA) to capital ratio predicted by the model under baseline calibration.

Table 6: Model and Data–Other variables

	Model	Data
	ratio of means	
investment/K	0.12	0.08
revenues/K	0.95	0.96
	ratio of std dev	
investment/K	0.12	0.12
revenues/K	0.96	0.92
	autocorrelation	
investment	0.65	0.74
revenues	0.97	0.99

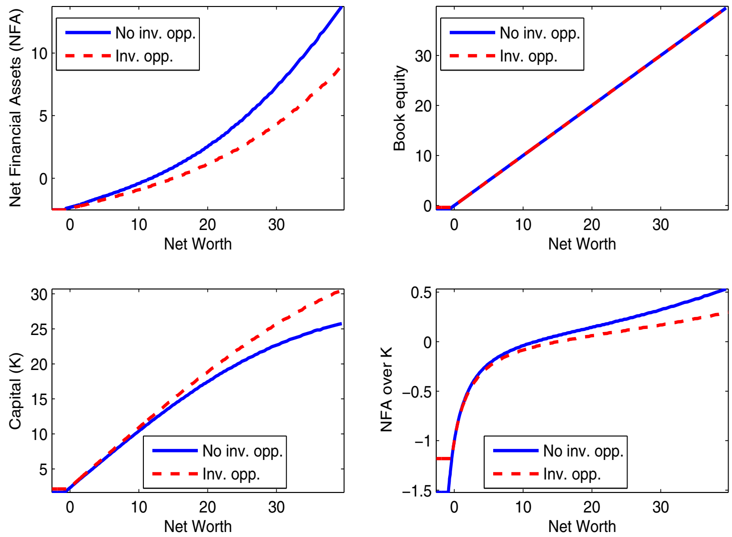
Note: This table reports the means of investment and revenues relative to the mean of capital; and the same for the standard deviation. The last two rows report the autocorrelation coefficient for investment and revenues. All moments are presented for the data (Compustat sample, 2000-2007 period) and as predicted by the model under baseline calibration.

Table 7: Model and Data–Shareholder payouts

	Model	Data
mean(distrib)/mean(K)	0.06	0.04
std(distrib)/std(K)	0.05	0.06
autocorr	0.94	0.73

Note: This table reports the mean and standard deviation of shareholder payouts relative to the mean and standard deviation of capital; as well as the autocorrelation coefficient for shareholder payouts. All moments are presented for the data (Compustat sample, 2000-2007 period) and as predicted by the model under baseline calibration.

Figure 4: Policy functions



Note: This figure plots the policy functions for net financial assets (NFA), capital, book equity and the ratio of NFA to capital as functions of net worth, for a firm in productivity state z_4 without an investment opportunity (solid lines marked 'No inv.opp.') and with an investment opportunity (dashed lines marked 'Inv.opp.').

Table 8: Model and Data - Conditional means

	Model	Data
Ratio X | NFA>0 to X | NFA≤ 0 :		
investment/K	1.26	1.28
revenues/K	1.10	1.31
BE/K	2.32	2.99
(ΔBE)/K	1.43	1.21

Note: This table reports the ratio of means of investment, revenues, book equity and annual changes in book equity, for firms with positive and non-positive net financial assets (NFA). All moments are presented for the data (Compustat sample, 2000-2007 period) and as predicted by the model under baseline calibration.

Table 9: Dividend tax $\tau^d = .28$

	1970s	
NFA/K	Data	Model
mean	-0.12	-0.06
median	-0.17	-0.16
$\Pr(NFA > 0)$	26.9%	32.3%
std dev	0.39	0.59
10pct	-0.50	-0.52
25pct	-0.34	-0.44
75pct	0.02	0.07
90pct	0.29	1.00

Note: This table reports the moments from the distribution of net financial assets (NFA) to capital from the model evaluated at a higher dividend tax $\tau^d = 0.28$ and compares them with the data (Compustat sample, 1970s). Pr refers to probability, pct refers to percentile.

Table 10: Alternative productivity process - Operational loss ϕ_i

	State i								
	1	2	3	4	5	6	7	8	9
Baseline (2000s)	.13	.12	.04	.04	.04	.035	.035	.035	.03
Less loses (1970s)	.10	.06	.03	.02	.02	.015	.015	.015	.015

Note: This table presents the probabilities of transitioning into operational losses, ϕ_i, from productivity state i in the baseline model calibration and in the calibration for the 1970s.

Table 11: Lower idiosyncratic risk in 1970s

	Data	Model		
	1970s	2000s	1970s	
		Baseline	Baseline	Lower risk
NFA/K				
mean	-0.12	0.06	-0.06	-0.11
median	-0.17	-0.07	-0.16	-0.14
$\Pr(NFA > 0)$	26.9%	41.8%	32.3%	31.4%
std dev	0.39	0.67	0.59	0.57
10pct	-0.50	-0.51	-0.52	-0.62
25pct	-0.34	-0.39	-0.44	-0.55
75pct	0.02	0.23	0.07	0.02
90pct	0.29	1.65	1.00	0.52

Note: This table contrasts the moments of net financial assets (NFA) to capital distribution in the data for the 1970s in the Compustat sample (column marked 'Data 1970s') with those obtained from the model under the baseline calibration (column marked '2000s Baseline'); from the model evaluated at a higher dividend tax $\tau^d = 0.28$ (column marked '1970s Baseline'); and from the model evaluated at $\tau^d = 0.28$ and lower incidence of operational losses (column marked '1970s Lower risk'). Pr refers to probability, pct refers to percentile.