The Macroeconomics of Firms' Savings*

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May 11, 2011

PRELIMINARY AND INCOMPLETE

Abstract

The U.S. non-financial corporate sector became a net lender in the early 2000s. In this paper we seek to understand why firms simultaneously carry net savings yet rely on equity financing. We first document the rise in corporate savings since 1970s, and provide an account of which firms have become net savers. We develop a theoretical framework that rationalizes these observations. Debt is fiscally advantageous but subject to a no-default borrowing constraint. On the other hand, equity allows to suspend distributions to shareholders in response to a negative shock. As a result equity is valued to hedge investment risk, and since firms can achieve only partial insurance with equity, they also accumulate savings for precautionary reasons. We show that our model can match the large fraction of firms with positive net savings, and correctly predicts a number of additional cross-sectional moments. We then use the model to understand the factors behind the rise of corporate net savings in the U.S. over the past 40 years and show that a large fraction of that increase can be attributed to a fall in cost of equity relative to debt. The latter is primarily due to a decline in dividend taxes in the 1980s and 1990s.

Keywords: Corporate savings, debt, equity, dividend taxation.

1 Introduction

In the last 40 years several developed economies have experienced large changes in the level and composition of private savings. For the U.S., the ratio of net private savings to GNP dropped from 10 percent in the 1970s to less than 4 percent at the beginning of the 2000s. The composition of private savings has experienced even more dramatic changes. While U.S. households have set out on a path of lower and lower savings, the corporate sector has emerged as a large saver. In the 1970s and 1980s the corporate sector was a net debtor, borrowing between 15 and 20 percent of the value of its tangible assets (capital henceforth) from the rest of the

*We thank Paul Beaudry, Mitch Berlin, Michael Devereux, Burcu Eyigungor, Amartya Lahiri, and the audiences at the University of British Columbia, Wharton School, and FRB Philadelphia for their comments and suggestions. The views expressed here do not necessarily reflect the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

economy.[1] The corporate sector then switched to being a net *lender* in the 2000s, following a rapid transition phase in the 1990s. The corporate net savings position, defined as the difference between financial assets and debt liabilities, has been above 5 percent the value of its capital for the period 2003-2007.

As investment has remained stable in relationship to output, equity has sharply outgrown capital since the 1970s, suggesting an overall shift in the capital structure of firms away from debt financing and towards equity financing. Equity was equal to 85 percent of corporate sector's tangible assets in the 1970s and 1980s, the ratio increased above 1 in the 2000s.[2]

In this paper we study the emergence of the corporate sector as a net lender in the U.S. In order to understand better which firms have become net savers and why, we shift our attention to the Compustat database. It contains detailed historical information about balance sheets of publicly traded firms in the U.S. We show that the trends we uncovered in the aggregate data for the period 1970-2007 also emerge in the disaggregated firm-level data.[3] In particular, we find that median net savings to capital rose over the sample period, from -0.18 in the 1970s to -0.05 in the 2000s. In fact, about 40 percent of the firms in our sample were carrying positive average net savings in the period 2000-2007—almost double the share observed in the 1970s. The increase in the mean net savings to capital ratio was even more pronounced: from -0.12 in the 1970s to 0.11 in the 2000s. We also characterize the dynamics of net savings along industry, firm-size, firm-age and 'entry'-cohort dimensions and show that the rise of net savings is particularly pronounced for manufacturing and service sectors, small and medium size firms, and younger firms.[4]

Why we observe so many firms simultaneously carrying net savings yet actively relying in equity to finance investment? Internal funds appear to be preferable to external funds and, if the latter are needed, debt offers several advantages over equity. First, interest payments are tax deductible, while equity suffers from several fiscal disadvantages. In addition, equity has significant floatation costs, can worsen agency problems by bringing external ownership into the company, and may be associated with a negative signal regarding the quality of the firm.[5] Thus from a cost perspective firms should adhere to a hierarchy of financing sources: first they should rely on internal funds; if external finance is needed, debt should be preferred to equity, which

[1]We define the corporate sector as non-farm, non-financial corporations. Data are from Flow of Funds (FoF henceforth).

[2]In the last 20 years U.S. firms have also increasingly relied on public equity. According to Moskowitz and Vissing-Jorgensen (2002), the ratio of public to private equity increased threefold from 1989 to 1998. The number of U.S. firms listed on NYSE or NASDAQ grew 33 percent over the same period.

[3]We restrict our sample to all non-financial, non-technology firms, as well as eliminate regulated utilities. Net savings are computed as the difference between financial assets and liabilities, while equity is defined as financial plus tangible assets minus liabilities. All variables are computed as ratios of tangible assets (capital) to account for firm scale. More details on the data are provided in Section 2 and in the Appendix.

[4]We identify the entry year of the firm with the entry year in the Compustat database.

[5]Frank and Goyal (2008) offers an overview of corporate debt literature and notes that most existing theories cannot explain the low leverage levels observed in the data. Hennessy and Whited (2005) study leverage choice in a dynamic structural model: our approach has several features in common with theirs.

becomes a finance source of last resort.

We argue firms rely on equity as it allows them to hedge against negative cash flows, while firms simultaneously increase their net savings position in order to avoid being financially constrained in the future. There are two key premises to our theory. First, firms may be unable to resort to further borrowing following a shock, so they must resort to costly equity to finance their investment needs. Thus firms strive to accumulate net savings in order to avoid being borrowing constrained. Second, dividend payments are suspended whenever a firm faces a negative cash flow, thus offering insurance against this possibility. The borrowing constraint, coupled with the costly equity, implies that firms' problem is strictly concave even if the underlying objective function is risk neutral. As a result firms value the insurance properties of equity and are willing to issue equity despite its higher cost. However, since equity only provides incomplete insurance, the "precautionary motive" for net-savings co-exists with the demand for equity.

More precisely, we set up a partial-equilibrium model where firms are heterogeneous regarding their net worth and productivity level. There are two external sources of finance: risk-free debt and equity. Firms face a borrowing constraint—derived from the model primitives—that ensures that debt repayment is feasible in all states. Whenever the constraint is binding, firms must resort to equity to finance the desired level of investment. We model equity as a one-period claim on net revenues subject to non-negativity constraint on dividends. Whenever the firm faces a negative cash flow—an event we label a "distress" shock—shareholders receive no distributions, providing some financial relief to the firm. Finally we derive the price of equity from the arbitrage condition associated with a risk-neutral household.

We focus on fiscal considerations to calibrate the cost of equity relative to debt as independent estimates of tax rates across time are readily available. From the side of the firm, debt is fiscally advantageous since interest payments are tax deductible. Households also demand an additional premium for equity as compensation for dividend taxation.[6]

We show our theory of equity can match quantitatively the large fraction of firms with positive net savings. We set the productivity process to match the mean and median net savings to capital in the data for the period 2000-2007, as well as the cross-section relationship with size.[7] The calibrated model predicts a large share of firms with positive net savings, very close to the data: 39 percent versus 41 percent in the data. Overall, the model provides a remarkable fit of the overall distribution of net savings to capital, matching the fat right tail in the data. In addition, the model also fits the left tail, suggesting that our specification for the borrowing constraint is not too tight.

[6] We recognize there are several other important considerations in regard the costs and benefits of equity. See Frank and Goyal (2008) and Tirole (2006).

[7] In order to replicate the sample of firms in Compustat, we focus on those firms in the model that have a strictly positive probability of issuing equity in the next period.

Investment demand plays a key role for the quantitative results. Firms with a high demand for finance due to high expected productivity are also exposed to large risk, as in the event of distress the firm's capital stock will be devastated. Firms then hedge against the investment risk by issuing equity beyond their financial needs and saving the additional finance resources. Doing so increases the internal resources available in the event of distress, and allows the firm to avoid being severely borrowing constrained. In contrast, firms with low demand for investment issue equity only as a finance of last resort, and strictly adhere to the hierarchy between debt and equity among external sources of financing. However, these firms still accumulate net savings for precautionary reasons.

Our model also provides a structural framework to explore the factors behind the rise in corporate savings in the last 40 years. More precisely, we put to test the hypothesis that changes in dividend taxation have played a prominent role. McGrattan and Prescott (2005) argue that changes in the U.S. tax and regulatory system regarding corporate distributions can explain large secular movements in corporate equity.[8] According to our calculations, the changes in taxation and regulations in the 1980s and 1990s, up to the tax reform of 2003, halved the cost of equity relative to debt.

We then calibrate the cost of equity to the dividend tax rates observed in the 1970s, leaving all other parameters intact. We find that the model predicts that the ratio of net savings to capital would be negative, around $-.2$—slightly lower than the actual ratio observed for the 1970s in our sample. Remarkably, the model prediction for the share of firms with positive net savings is spot on with the data at 26 percent. The model also correctly predicts that net savings to capital are flat with respect to size in the 1970s. The model, though, has a larger downward shift on the left tail than we observe in the data, suggesting additional factors, like access to public equity, may have played an important part in the rise of corporate savings.

In the recent years there has been an increased interest in dynamic models of corporate finance. Gomes (2001) uses a structural model of investment where heterogeneous firms face a costly external finance in order to study the effect of cash flows on investment. As most of the literature, Gomes (2001) focuses on firm-level facts and relies on a reduced-form specification for equity. Hennessy and Whited (2005) develop the so-called trade-off theory in a dynamic structural model and focus on observed leverage ratios.[9]

McGrattan and Prescott (2005) argue that changes in taxes and regulations can explain the large increase in firm value relative to GDP. Following Jobs and Growth Tax Relief Reconciliation Act of 2003 several papers have seek to understand better how dividend and capital gains taxes

[8]McGrattan and Prescott (2005) assume equity is the only source of financing for firms and thus they are not equipped to study the behavior of corporate net savings. See also Poterba (2004) for further discussion on the taxation of corporate distributions.

[9]See also Riddick and Whited (2009).

affect capital structure and investment. Chetty and Saez (2005) and Chetty and Saez (2006) examine the evidence on corporate distributions and find an increase in dividend payments. Gourio and Miao (2010) focus on the long-run effects of dividend taxation on the capital-to-output ratio.[10]

The paper is organized as follows. Section 2 documents the key facts regarding corporate savings for the period 1970-2007. Section 3 describes the model setup and defines the industry equilibrium. We discuss how our model generates a simultaneous demand for equity and net savings in Section 4. We then turn to our quantitative analysis. Section 5 documents our calibration and Section 6 discusses the model fit and the key quantitative determinants of positive net savings. Finally Section 7 answers what is behind the rise in corporate savings from 1970 to 2007. We conclude in Section 8. The Appendix contains a more detailed description of the data as well as several technical results regarding the model.

2 The rise of corporate savings 1970-2007

In this section we document key empirical developments in the capital structure of U.S. corporate sector. Our aggregate data is from the Flow of Funds Accounts of the United States. We focus on the nonfarm, nonfinancial corporate business data on the levels of financial assets, tangible assets, liabilities and net worth during 1970-2007 period. We compute net savings as the difference between financial assets and liabilities, while equity is obtained as net worth. In all cases, we scale the variables by tangible assets, which provide a measure of firms capital stock. All variables are measured at market value.[11]

Figure 1 shows the dynamics of net savings to capital ratio during 1970-2007 period. It shows that aggregate net savings to capital were relatively stable at -0.15 during 1970s and 1980s, experienced a dramatic run-up during the 1990s, stabilizing again at around 0.03 in the 2000s. 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. The increase in net savings was also accompanied by a rise in equity financing, where the net worth of U.S. corporate sector as a share of its capital has increased from 0.85 in the 1970s and 1980s to 1.03 in the 2000s.[12]

Who is behind these aggregate changes? Which firms have become net savers and why? To

[10] See also Gourio and Miao (forthcoming).

[11] Flow of Funds dataset also contains the value of financial and tangible assets at historical cost. We find that using these variables does not change the trends in the ratios of net savings and equity to capital, but raises their levels.

[12] An increase in net savings to capital ratio was accompanied by a rise in both asset and liability positions of the corporate sector, with assets rising faster than liabilities. The increase in assets is primarily driven by a rise in firms holdings of cash and other liquid short-term assets; while on the liability side the increase is due to higher short-term debt. Detailed discussion of these trends and decompositions is included in the Appendix.

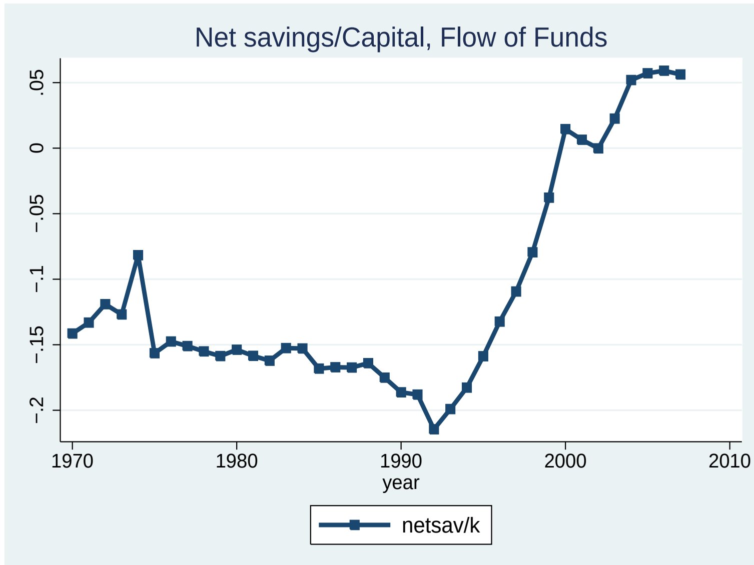

Figure 1: U.S. non-farm, non-financial corporate sector NS, share of K

answer these questions we turn to disaggregated firm-level data from Compustat. We focus on U.S. firms only; exclude technology, financial firms, as well as regulated utilities. We also drop the firms whose capital is below 50,000 USD, and those with negative equity.[13] This selection leaves us a sample of about 5000 firms in the 1970s, 6700 firms in the 1980s, 8200 firm in the 1990s, and 6600 firms in the 2000s. In line with the definitions used in the Flow of Funds data, we construct our measure of net savings in the Compustat database. 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.

We begin by reporting the mean and median of net savings to capital ratio. We focus on this measure to control for the outliers in our dataset.[14] Figure 2 presents our results.

It is easy to see that Compustat firms mimic the trends we uncovered in the aggregate data. Both mean and median net savings to capital are rising steadily over time. Mean turns positive in the mid-1990s, reaching about 12 percent in 2006-2007. The median net savings to capital ratio, although rises sharply over the past 40 years, does not turn positive in the 2000s.[15] Figure

[13]We exclude technology firms from our analysis due to a potentially serious mismeasurement of their capital stock, which is predominantly intangible.

[14]We also looked at the ratio of mean net savings to mean capital, and the same ratio for medians. We found that the ratio of medians exhibits the same trends as presented 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 dataset. Those results can be found in the Appendix.

[15]The Compustat data also does not exhibit as dramatic a run-up in net savings to capital in the 1990s as we

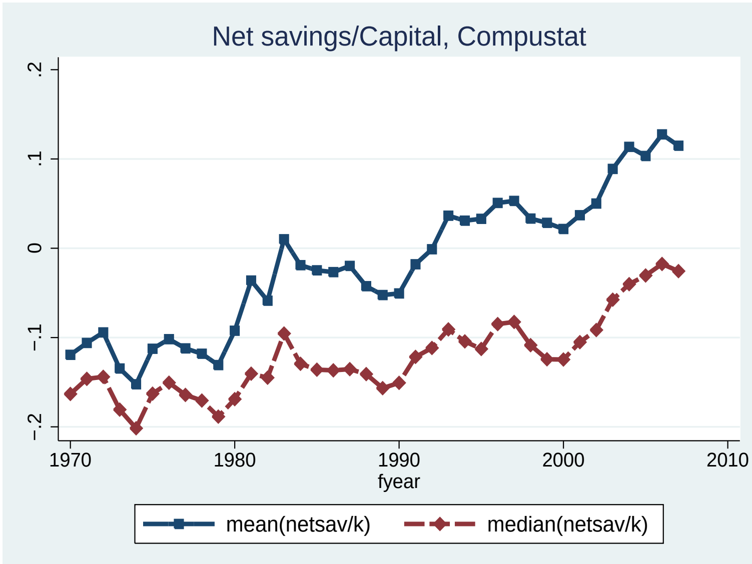

Figure 2: U.S. Non-financial, non-utilities, non-technology corporate sector NS, share of K

3 takes a closer look at the distributions of net savings to capital in the 1970s and 2000s.

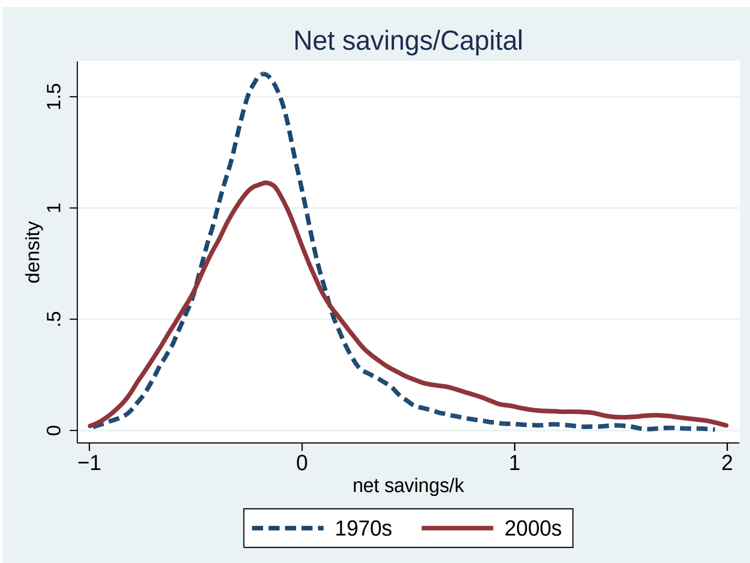

Figure 3: Net savings to capital density, 1970s and 2000s

observed in the Flow of Funds series. The difference is partially due to the exclusion of the Technology sector from the Compustat sample. In the Appendix A we show that while the rise in net savings to capital ratio is characteristic of all industries in the U.S., the Technology sector has shown the sharpest increase. In fact, starting in the late 1980s, technology firms have had the largest median net savings to median capital ratio of all sectors; with this ratio remaining high ever since. Combined with the growing share of that sector in the U.S. economy, this could have contributed to the sharp rise of corporate savings in the 1990s in the aggregate Flow of Funds data.

Several features stand out on that figure: (i) there is a rightward shift in the distributions of net saving to capital in the 2000s relative to the 1970s; (ii) majority of this shift is due to an increase in the share of firms with positive net savings, resulting in fatter right tail of the distribution; (iii) at the same time, the left tail of the distribution almost did not change. The moments of the net savings to capital distributions during the two decades are summarized in Table 1.

Table 1: Moments of net savings to capital distribution

	share of firms with netsav2k >0	netsav2k mean	median	skeweness	std dev	10pct	25pct	75pct	90pct
1970s	25.42	-0.12	-0.18	2.54	0.43	-0.52	-0.36	0.00	0.28
2000s	41.44	0.11	-0.05	1.66	0.72	-0.56	-0.35	0.32	1.09

Both mean and median of net savings to capital show a dramatic increase over time in our sample. Median has increased from -0.18 in the 1970s to -0.05 in the 2000s, while mean has almost doubled during the same period. The upper percentiles of the net savings to capital distribution have shown even more pronounced rise, while the bottom percentiles have barely changed over time. Finally, the share of firms in our dataset with positive net savings has increased from 25 percent in the 1970s to 41 percent in 2000s.

Who are the firms driving a rise in net savings? To address this question, we study net savings positions conditional on firm size, industry, and entry cohort. Figure 4 plots the level of net savings for firms of different size, where the size is measures by the number of firm employees, in the 1970s and 2000s. The figure makes clear that small- and medium-size firms (with the size up to the median-employment) have experienced the largest increase in net savings to capital ratio. While net savings and employment don't show much association in the 1970s, the relationship becomes clearly decreasing in the 2000s.

In the Appendix we also report the levels and dynamics of net savings to capital ratio for different industries and entry cohorts. Overall, our findings suggest that small to medium size firm, those in manufacturing and services, and entrants into Compustat are responsible for the dramatic rise in net savings we uncovered in the aggregate data. In the next section we develop a theoretical framework aiming to understand both time-series developments and the cross-sectional facts about firms net savings.

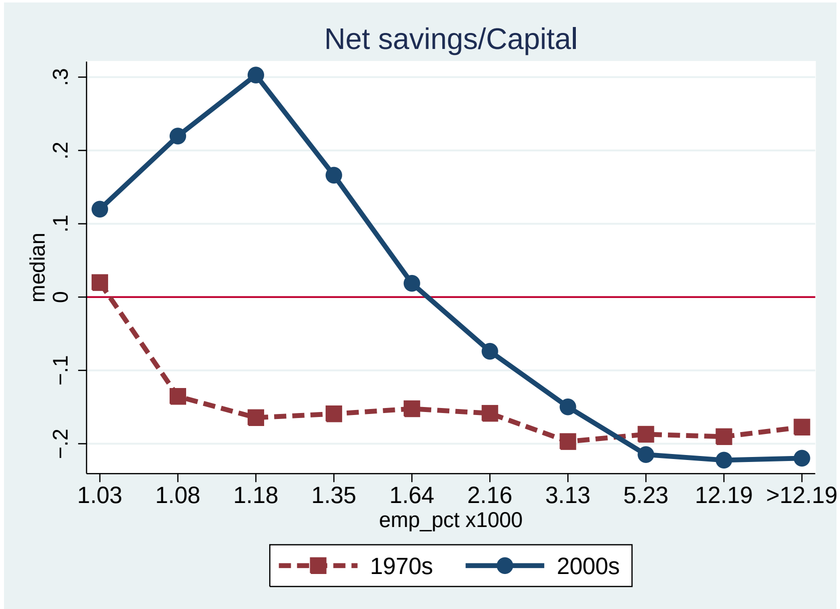

Figure 4: Net savings to capital by firm size

3 Set up

We set up a partial-equilibrium model of the corporate sector. There is a continuum of entrepreneurs. Each entrepreneur is risk neutral and seeks to maximize

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t c_t \right\}$$

where $\beta \in (0,1)$ is the intertemporal discount factor and c_t is non-negative consumption.

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

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

where $z \in Z$ is an idiosyncratic productivity shock governed by a Markov stochastic process $\mu(z'|z) > 0, \forall z, z' \in Z$. Parameters $\nu, \eta > 0$ satisfy $\eta + \nu < 1$. In particular, η captures the income rents associated with the entrepreneur's input, which we assume it cannot be traded. Finally $\delta > 0$ is the depreciation rate of capital.

Labor is hired at a spot market at exogenously given wage rate w. The firm must also pay a corporate tax rate τ^c on earnings before interest minus capital depreciation expenses. In addition we introduce the possibility that a firm suffers cash flow loss by including additional after-tax costs $c^f(z,k)$,

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

Operational losses play an important role in our model. Firms will periodically have to use finance to cover the cash shortfall, possibly in states of the world where their immediate prospects are not very high.[16] This, in turn, would provide the basis of the precautionary demand for net savings.[17] The additional expenses may be due to overhead costs, minimum scale requirements, product obsolescence, or, more exceptionally, liabilities or accidents.

The productivity process is such that $\pi(k,z)$ is ranked according to z for all k. The set of possible states is $\{z_1, z_2, \ldots, z_n\}$ we have that

$$\pi(k,z_1) < \pi(k,z_2) < \cdots < \pi(k,z_n)$$

for all $k \geq 0$. We assume a special set of properties for state z_1, which we call "distress." In particular, we set $c^f(z_1,k)$ such that

$$\pi(k_t,z_t) = -\kappa$$

with $\kappa \geq 0$. For all other states, $z > 0$ and $c^f(z,k) = 0$. Thus "distress" is the only state in which a firm suffers a negative cash flow and past investments are fully depreciated.

Investment k_t must be financed one period ahead. To do so, an entrepreneur may rely on internal funds, debt, or additional equity. Let us start with equity. We assume the entrepreneur can issue claims to next period's net revenues. Given investment k_t, each share s_t issued at date t will produce a dividend

$$d(k_t, z_{t+1}) = \max\{\pi(k_t, z_{t+1}), 0\}$$

at date $t+1$. Actual dividend payout thus depends on investment at date t, and the realization of productivity in the next period z_{t+1}. Dividends must be non-negative: since the firm's cash flow is negative at state z_1, dividends are zero with positive probability. To keep the model tractable, equity is one-period lived.

Firms take equity price schedules $p(k_t, z_t)$ as given—we will derive those later from the arbitrage condition of a stand-in household. Shareholders do not exert any control upon the firm, and the entrepreneur remains the sole decision-maker. Thus we can interpret the entrepreneur's residual claims to the firm as "inside equity," while additional issuances—an active decision by

[16] Productivity shocks, by themselves, do not generate much demand for finance. Firms want to expand their investments in response to positive productivity shocks, but the associated increase in cash flows allows the firm to self-finance its expansion.

[17] Lins et al. (2010) document that CFOs use cash to guard against future cash flow shocks in bad times. Lines of credit, due to financial covenants, are not a good substitute. See Sufi (2009).

the firm—are to be considered as “outside equity.” We also assume that it is not possible to issue claims in excess of cash flow and thus $s_t \leq 1$. Similarly, entrepreneurs cannot short themselves, and thus $s_t \geq 0$.

Debt is risk-free with exogenous pre-tax gross return $1 + \tilde{r} > 1$.[18] Since interest expenses deduct from corporate taxes due, the after-tax gross return is $1+r = 1+(1-\tau^c)\tilde{r}$. The firm can also save at the same rate. Let a_t denote the savings position at date t, that is, $a_t > 0$ denotes positive savings (and thus internal funds), and $a_t < 0$ denotes debt.

Since debt is risk-free, we must ensure it is feasible to repay outstanding debt with probability one. This no-default condition implies the following borrowing constraint:

$$a_{t+1} \geq -\alpha, \tag{2}$$

where

$$\alpha = \min_z \max_{k'} \left\{ \frac{p(k', z) - k' - \kappa}{r} \right\}.$$

In the Appendix we discuss the steps to derive the borrowing constraint, as well as conditions such that $\alpha > 0$.

We are now ready to set up the entrepreneur's problem. Entrepreneurs problem choose plans for net savings a_t, capital k_t, equity s_t, and consumption c_t to maximize

$$\sum_{t=0}^{\infty} \beta^t E\{c_t\},$$

subject to budget constraint

$$\frac{c_t}{1-\tau^d} + a_{t+1} + k_{t+1} \leq \pi(k_t, z_t) + (1+r)a_t - d_t s_t + p_t s_{t+1} \tag{3}$$

as well as

$$\begin{aligned} c_t &\geq 0 \\ a_{t+1} &\geq -\alpha \\ s_{t+1} &\in [0, 1] \end{aligned}$$

at all dates $t \geq 0$. Proceeds from the firm to the entrepreneur are taxed at the dividend tax rate τ^d.

[18] All variables in the model are in real terms.

The entrepreneur problem can be stated recursively by defining the state variable net worth

$$\omega_{t+1} = \pi(k_{t+1}, z_{t+1}) + (1+r)a_{t+1} - d_{t+1}s_{t+1}.$$

New 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 entrepreneur can tap into. Net worth is bounded below by $\omega^b \equiv -\kappa - (1+r)\alpha$, which is the worst possible realization of the net worth for a firm which is at debt capacity. 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 in two stages. Given state $\{\omega, z\}$, the entrepreneur decides how much to invest:

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

where $V : \Omega \times Z \rightarrow \Re_+$ is bounded and $\Gamma(\omega, z) : \Omega \times Z \rightrightarrows \Re_+$ is a correspondence with non-empty compact image.[19] With k' as given, the entrepreneur decides the best way to finance investment, and whether to consume

$$J(k', \omega, z) = \max_{c, a', s'} c + \beta E_z V(\omega'(z'), z')$$

subject to the following constraints

$$\frac{c}{1-\tau^d} + a' + k' \leq \omega + p(k', z)s',$$
$$c \geq 0,$$
$$a' \geq -\alpha,$$
$$s' \in [0, 1],$$

where

$$\omega'(z') = \pi(k', z') + (1+r)a' - d(k', z')s'$$

for all $z' \in Z$. We denote by $\psi^x : \Omega \times Z \rightarrow \Re$ the resulting policy functions for $x \in \{c, k', a', s'\}$. We also obtain a law of motion for net worth, $\psi^\omega(\omega, z, z')$.

3.1 Equity prices

Ours being a partial equilibrium model, the equity price schedule $p(k, z)$ is taken as exogenous. However, we want to choose a specification that allows flexibility while relating the cost of equity

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

to the dividend process as well as fiscal considerations. To this end we postulate

$$p(k,z) = \xi(1+r)^{-1}E\left\{d(k,z')|z\right\} \tag{4}$$

where $\xi > 0$ is a "markdown" parameter that summarizes the relative cost of equity and debt from the point of view of the firm. If $\xi = 1$ the firm is indeed indifferent between debt and equity, and the Miller-Modigliani theorem holds. If $\xi < 1$ equity is relatively costly so, absent any other friction, the firm prefers to use debt to finance itself.

While we have assumed equity is one period-lived for computational reasons, firms will renew the stock of equity period to period. It is thus possible to use (4) to price longer-lived assets. Special care, though, is then needed when setting the markdown parameter. In Section 5 we show how to map the fiscal treatment of an infinite-lived asset into parameter ξ.

3.2 Industry equilibrium

We finally close the model description. Let $F_t(\omega, z)$ be the cumulative distribution function of firms over net worth and productivity, with support $\Omega \times Z$. Firms exit exogenously at rate $\varkappa > 0$—the entrepreneur gets zero revenue flow from the exit date onwards.[20] The borrowing constraint indeed ensures a firm retains positive value at all dates, and thus liquidation is never optimal. We assume each period there is a flow of new entrants replacing exiting firms. The joint distribution of net worth and productivity is given by c.d.f. $G(\omega, z)$, with support $\Omega \times Z$.

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

$$F_{t+1}(\omega', z') = \varkappa G(\omega', z') + (1-\varkappa)\sum_{z \in Z} \mu(z'|z) F_t\left(\phi(\omega', z, z')\right) \tag{5}$$

where $\phi(\omega', z, z') = \sup\left\{\omega \in \Omega : \psi^\omega(\omega, z, z') \leq \omega'\right\}$.

Our focus in this paper is a stationary industry equilibrium with $F_t = F_{t+1}$.

Definition 1 *A* ***stationary industry equilibrium*** *is a stationary distribution F and policy functions $\left\{\psi^a, \psi^c, \psi^s, \psi^k, \psi^\omega\right\}$ such that policy functions solve the entrepreneur's problem given prices and taxes, and F satisfies the law of motion (5).*

A sufficient condition for a stationary industry equilibrium to exist is that $1 + r = \beta^{-1}$ and $\varkappa > 0$. For the remaining of the paper we assume those two parameter conditions.

[20] The exit probability is embedded in their intertemporal discount rate β.

4 Net Savings and Equity

As simple as out model is, it can generate a simultaneous demand for net savings and equity. To understand how the model works, we roll back the constraints on debt and equity, and let the entrepreneur tap into as much debt or equity as needed.

Consider first the case with $\xi = 1$, that is, the after-tax expected return on debt and equity are the same. The Miller-Modigliani theorem applies and thus the capital structure of the firm is undetermined as the entrepreneur is indifferent between the two finance sources. 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.[21]

Let us re-introduce the borrowing constraint for the case of costly equity, $\xi < 1$. At first pass this seems of little help to generate demand for both net savings and equity. Debt-holders demand a lower return, and thus the entrepreneur prefers to finance fully with debt. Only if the firm is at debt capacity the entrepreneur would have to resort to equity for additional funding. Thus 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. We would not observe a firm actively rely on equity unless the firm carries a large debt load.

However, this argument misses a key observation: risk considerations come to play in the presence of borrowing constraints and costly equity. More formally, the entrepreneur's problem becomes strictly concave despite the underlying preferences being risk neutral. Consider a firm following the pecking order described above. If the firm has a high net worth, investment can be financed by own savings or debt. Thus an additional dollar of net worth is valued at the risk free return $1 + r$. A firm with low net worth, though, will hit debt capacity and will have to rely on equity. The higher finance cost not only reduces the value of the firm, but it also increases the value of an additional dollar of net worth: now one dollar allows the firm to save the expected return to equity, $(1 + r)/\xi$. Thus the firm values a dollar more when it has low net worth than when it has high net worth.

The risk of being at debt capacity introduces a precautionary motive for net savings. Firms strive to accumulate net worth in order to decrease the probability that they find themselves at debt capacity at future dates. Indeed, there are no distributions to the entrepreneur until the firm can self-finance itself at all future dates. Consider the first-order condition associated with net savings,

$$\lambda \geq \beta(1 + r)E\left\{V'\left(\omega'(z'), z'\right)|z\right\}$$

[21] 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: it would raise as much funds as possible from shareholders, and simply save the proceeds.

with strict equality if the firm is not at debt capacity, $a' > -\alpha$, where λ is the Lagrangian multiplier associated with the budget constraint and thus the marginal benefit of net savings. The first-order condition associated with consumption implies that $\lambda \geq 1$. Using the envelope theorem, we can rewrite the previous first-order condition as

$$\lambda \geq E\left\{\lambda' \middle| z\right\}$$

where we have also used the condition $(1+r)\beta = 1$. Thus λ is a supermartingale, and λ converges almost surely to its lower bound. Whenever the firm is at debt capacity, one more dollar would allow to relax the borrowing constraint, and thus it is more valuable, $\lambda > 1$. Thus the firm seeks to save as much net worth as possible in anticipation of states of the world where the debt capacity will bind. Only when there is zero probability that the borrowing constraint is ever binding, that is, when

$$\lambda = E\left\{\lambda' \middle| z\right\} = 1$$

for all $z \in Z$, there will be distributions to the entrepreneur.[22] Net savings allow firms to build up the net worth over time without introducing further risk or incurring in decreasing returns to capital.

Simultaneously, firms find equity valuable due to its insurance properties: dividend payments decrease when the firm has a bad productivity shock, and are zero altogether when the firm has no cash flow. Thus equity delivers some financial relief in the states where the firm will have lower net worth and thus is likely to face a higher finance cost. In asset-pricing parlance, firms are willing to pay an insurance-premium for equity.

Let us take a closer look of how the demand for both net savings and equity coexists. Consider the first-order condition associated with equity issuance,

$$p(k', z)\lambda = \beta E\left\{V'\left(\omega'(z'), z'\right) d(z')|z\right\},$$

where we have assumed positive issuance, $s' > 0$. We can rewrite this expression in terms of the covariance,

$$p(k', z)\lambda = \beta E\left\{V'\left(\omega'(z'), z'\right)\right\} E\left\{d(z')\right\} + \beta \text{Cov}\left(V'\left(\omega'(z'), z'\right), d(z')\right),$$

where we dropped the arguments where there is no confusion possible. Using the specification

[22] There exists a level of savings, a^*, such that the net return ra^* is sufficient to cover all finance needs in all states. Thus the entrepreneur can maintain the net savings position a^* with probability one, and consume the excess cash flow.

for the equity price, (4), and assuming the firm is not at debt capacity, we have that

$$E\left\{V'\left(\omega'(z'),z'\right)\right\}E\left\{\frac{d(z')}{p(k',z)}\right\}=\xi^{-1}(1+r)>1+r.$$

Thus firms would only take equity simultaneously if

$$\text{Cov}\left(V'\left(\omega'(z'),z'\right),\frac{d(z')}{p(k',z)}\right)<0.$$

This requires that V is strictly concave, and dividends are positively correlated with net worth. Note the precautionary motive remains because equity only provides partial insurance: if dividend payments would insure the firm from all shocks, there would be no precautionary motive. Similarly, demand for equity decreases as the firm accumulates net worth and lowers the chances that it hits the borrowing constraint in the near future.

There remains the question, though, of whether our model can generate the observed *positive* net savings among firms that rely on equity. We answer this question with a quantitative evaluation of our model.

5 Calibration

We turn now to the core question of the paper: can our model generate positive net savings as observed for the period 2000-2007? We choose to answer this question with a narrow focus on the fiscal cost of equity, which we can derive from statutory rates and estimates from the public finance literature. We recognize there are other factors affecting the costs and benefits of equity. However, fiscal considerations can be observed and quantified easily, so we do not need to infer the equity markdown from the very same facts we seek to explain.

We find that the model can match the median and mean net savings to capital, as well as the decreasing relationship with employment, with a reasonable productivity process.

5.1 The fiscal cost of equity

We focus on fiscal considerations to quantify the cost of equity relative to debt. We derive the price of an infinite lived equity claim accounting for all taxes, then compare it with the cost of debt financing for the firm. As a summary statistic the markdown parameter is defined as the ratio of the equity prices implied by the household and firm arbitrage condition respectively. We then impute the markdown to the one-period equity claim in the model.[23]

[23] We need to compute the fiscal cost in an infinitely-lived equity claim to account properly for the taxation of the net return and capital gains.

We first derive a risk-neutral household's arbitrage condition between equity and debt.[24] Tax liabilities are calculated in nominal terms. Let γ_p be the inflation rate, assumed to be deterministic. The pre-tax nominal interest rate is

$$1 + \tilde{R} = (1 + \tilde{r})(1 + \gamma_p),$$

where $\tilde{r}$ is the real interest rate, before taxes. The real gross after-tax return to debt is then

$$\rho^b = \frac{1 + (1 - \tau^i)\tilde{R}}{1 + \gamma_p} \tag{6}$$

where τ^i is the marginal tax rate on interest income and $\tilde{R}$ the gross nominal interest rate before taxes.

Now we turn to equity. We need to specify the payment schedule of the asset. First the asset is bought ex-dividends at date t. Let D_{t+1} be the dividend distribution at date $t+1$ and P_t the asset price at date t. The asset price grows at gross nominal rate $1 + \gamma_a$.[25]

One dollar invested in equity obtains $\frac{1}{P_t}$ shares, which generate pre-tax revenues

$$\frac{D_t}{P_t} + \frac{P_{t+1}}{P_t}$$

at date $t+1$. Taxes to be paid are

$$\tau^d \frac{D_t}{P_t} + \tau^g \frac{P_{t+1} - P_t}{P_t}$$

where τ^d is the marginal tax rate in dividends and τ^g the tax on capital gains. Note capital gains are accrued—unlike in the actual U.S. tax code, where they are only imposed on realization.[26]

The real gross after-tax return to equity is then

$$\rho^d = (1 - \tau^d)\frac{d}{p_t} + \frac{1 + \gamma_a(1 - \tau^g)}{1 + \gamma_p} \tag{7}$$

where $d = \frac{D_{t+1}}{1+\gamma_p}$ and $p = P_t$ are the dividend and asset price in real terms.

[24] We must emphasize we do not model the household side: we just take the household's optimality condition in order to price equity and debt.

[25] This formulation allows for real growth in addition to inflation, as γ_a may be larger than γ_p.

[26] As long as we maintain the assumption of linear tax rates, the same calculations go through for an equity claim with stochastic return.

We now equate the returns (6) and (7) to solve for p,[27]

$$p = \frac{(1-\tau^d)d}{\frac{1-\tau^i}{1+\gamma_p}\tilde{R} - (1-\tau^g)\frac{\gamma_a}{1+\gamma_p}}. \tag{8}$$

In order to compute the mark-down, we have to derive the relative cost of debt and equity for the firm. The cost of debt, in gross after-tax terms is

$$\frac{1+(1-\tau^c)\tilde{R}}{1+\gamma_p},$$

where τ^c is the corporate tax rate. Consider now the equity price that would leave a risk-neutral, unconstrained firm indifferent. The cost of equity is

$$\frac{D_t + Q_{t+1}}{Q_t}$$

where Q_t is such price. Equating with the cost of debt, we obtain

$$q = \frac{d}{\frac{(1-\tau^c)\tilde{R}-\gamma_a}{1+\gamma_p}}. \tag{9}$$

Note that γ_a is an increased cost for equity, so if $\gamma_a > (1-\tau^c)\tilde{R}$, that is, if the net growth rate of asset is more than the net after-tax nominal interest rate, no positive asset price can induce the firm to issue equity.

Finally, we compute the markdown by taking the ratio of p from (8) and q from (9), that is $p = \xi q$, to obtain:

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

Note the dividend d cancels, so the markdown is independent of how shares are defined. While the inflation rate does not enter the expression explicitly either, $\tilde{R}$ is the nominal interest rate.

5.2 Taxes and interest rate

We pick tax rates and interest rates representative of the period 2000-2007 for the U.S. Our choices are summarized in Table 2. Let us start with the corporate tax rate, τ^c. Due the investment not being expended for tax purposes, the corporate tax rate directly impacts the

[27] For the equity price to be positive, it must be that

$$(1-\tau^i)\tilde{R} - (1-\tau^g)\gamma_a > 0.$$

Otherwise the asset price appreciation would, by itself, pay a higher return than savings.

	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 interest rate	$\tilde{R}$	0.07
Equity mark-down	ξ	0.82

Table 2: Taxes and interest rate — Baseline calibration

firm's decision beyond its implications for the relative cost of equity. In the U.S. the corporate tax code specifies a flat tax rate of 34 percent from \$ 335,000 to \$ 10 million, and caps the marginal rate at 35 percent.[28] The literature has an ample consensus on setting $\tau^c = .34$, and we follow suit.

Interest income is taxed at the federal income tax rate, and thus varies across investors. Wealth, though, is heavily concentrated on the right tail, so we choose a tax rate close to the top rate, $\tau^i = .34$, which is slightly higher than estimates of the average marginal tax rate across households.[29] The pre-tax nominal interest rate is set at 7 percent, and assume an inflation rate of 2 percent. This results on an after-tax real rate of 2.5 percent.

Now we turn to the taxation of equity. The period 2000-2007 includes an important tax reform, the Jobs and Growth Tax Relief Reconciliation Act of 2003. The act equated dividend and capital gain tax rates at 15 percent, although there are several caveats. First, Poterba (1987) argues that the effective capital-gains tax rate is one fourth of the statutory rate, due to gain referral and step-up basis at death. Second, some low income households are subject to a lower dividend tax rate of 12 percent, while some other households may end up with a rate above 15 due to the alternative minimum tax.[30] Third, some corporate investors do not pay dividend taxes, and the share of equity held by them as increased sharply over time.[31] We note, though, that most estimates track closely the statutory rates in the decade of 2000's. We thus decide to go with rates $\tau^d = .15$ and $\tau^g = .15$. If anything, these rates are likely to overstate slightly the fiscal cost of equity.

[28]Only small businesses and S corporations getting a rate below 30 percent.

[29]Poterba (2002) and NBER TAXSIM estimates tend to be just below 30 percent. Some bonds are tax-exempt, which reduces the average marginal tax rate. However, corporate bonds are always fully taxed.

[30]For example, Poterba (2004) reports an average marginal tax rate on dividends of 18 percent. A similar situation arises regarding capital gains taxes.

[31]For example, pension funds and other fiduciary institutions. See McGrattan and Prescott (2005) for a discussion.

	Parameter	Value
Discount factor	β	0.96
Entrepreneur rent	η	0.04
Depreciation rate	δ	0.10
Capital share	υ	0.25
Entry rate	$\varkappa$	0.02

Table 3: Preference and technology — Baseline calibration

5.3 Parameters

We discuss the values chosen for the parameters governing preferences and technology, which are set to match standard values in the literature. We postpone the calibration of the productivity process. We start with the parametrization of the production function. We set η to equate the entrepreneurs' rents to the share of dividends over GDP, roughly 4 percent. The capital share ν is set to .25, resulting in a total capital income share just below .3. We normalize the wage to $(\eta + \nu)/(1 - \eta - \nu)$ so employment is equal to net revenues. The depreciation rate is set to .1. For the entry rate we set a conservative value of 2 percent and we dispense with the distribution of entrants by setting the initial state to z_2 and a net worth tightly distributed close to ω^b. Finally the discount rate β is pinned down by our choice of the interest rate and the condition that $\beta R = 1$. The resulting value .96 is right on the standard value.

5.4 Productivity process

Finally, we ask whether it is possible to match the mean and median net savings to capital ratios observed for the period 2000-2007. In addition, we want to reproduce qualitatively the relationship of net savings with employment size, as we have seen that medium-size firms have been behind the change in the aggregate position of the corporate sector.

We specify a parsimonious productivity process with four states. The first state is distress, $z_1 = 0$. In order to reduce the degrees of freedom, we set $\kappa = 0$. Note that this still implies that a firm in distress has a negative EBIT. However, loses are now bounded by the previous investment level. We then set two persistent states with low and high productivity, coded as states 2 and 4 respectively. State 3 is a transition state between low and high productivity, which we label "investment opportunity." At that state, the firm knows there is a good chance it will have high productivity next period, but current productivity is not too high yet. This produces another state where the firm is likely to tap into outside finance.

Since we are targeting facts for publicly traded firms, we only look at firms in our model that have a positive probability of issuing equity in the next period. In our model firms with very high net worth rely exclusively on self-financing for investment—and thus have no need to tap outside investors. We consider these firms to be private equity.[32]

We have no trouble matching the mean and median net-savings-to-capital ratio in the data, and we are able to generate a decreasing relationship between net savings and employment. Productivity averages 1.5, with a standard deviation $\sigma[z] = 0.71$.[33] The matrix of transition probabilities is:

$$\mu(z'|z) = \begin{bmatrix} 0.27 & 0.32 & 0.2 & 0.21 \\ 0.10 & 0.80 & 0.09 & 0.01 \\ 0.10 & 0.30 & 0.10 & 0.50 \\ 0.27 & 0.01 & 0.14 & 0.58 \end{bmatrix}$$

Due to the parsimonious specification, the matrix of transition probabilities does not display a lot of persistence. Transitions to the distress state are quite frequent, but the share of firms in distress is small, about 15 percent, due to the mean reversion process. It is important to clarify that we target the net savings to capital ratio, not the levels of net savings or capital. Since our model takes a limited view of the sources of heterogeneity, we do not hope to match all the dispersion in asset size observed in the data.

6 The corporate sector as a net lender

Can our model replicate the positive level of net savings observed for the period 2000-2007? We are able to match the mean and median net savings to capital ratios in the data, 0.11 and -0.05 respectively. The model also generates the decreasing relationship between employment and the net savings to capital ratio. As documented in Section 5, we are able to do so with a very parsimonious calibration of the productivity process.

We emphasize that 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 net savings if we were to drop the borrowing constraint or the state-contingent dividend payments from the model. Without a borrowing constraint firms would finance only with debt, as it is the cheaper finance source. Without dividends payments providing partial insurance, only firms at debt capacity would resort to equity, and we would not observe firms with positive net savings actively relying on equity. Ours is not the only model capable of matching the data, but as Frank and Goyal (2008) highlight, traditional corporate finance models have a hard time explaining the low debt demand observed in the data.

We take a more careful look at the distribution of net savings, checking the model's prediction

[32]Note our sample includes all firms with debt: all private equity firms dropped carry positive net savings. Thus the censoring from the model does not help to generate positive net savings in the sample.

[33]The productivity levels are $z = [0, 1.63, 1.8, 2.15]$.

	2000s	
netsav2k	Data	Model
Calibrated		
mean	0.11	0.11
median	-0.05	-0.05
Non-calibrated		
netsav2k > 0	41.44%	39%
skeweness	1.66	0.61
std dev	0.72	0.89
10pct	-0.56	-0.67
25pct	-0.35	-0.10
75pct	0.32	0.11
90pct	1.09	1.43

Table 4: Model and Data — Baseline calibration

for those data moments that we did not calibrate. Table 4 reports our results. The model delivers a remarkably good fit of the overall distribution. The proportion of firms with positive net savings in the model is just a tad below the one in the data: 39 percent relative to 41 percent in the data. The model overshoots slightly the standard deviation observed in the data.

Table 4 also reports the quartiles as well as the 10 and 90 percentiles. The model track those in the data very closely. Figure 5 also plots the distribution of net savings to capital as generated by the model. As in the data, there is a large mass close to zero, a long right tail, and a shorter left tail. The good fit of the tails is important to validate the model. First, we are able to generate a significant fraction of firms with a very large net savings to capital ratio, as in the data. Second, matching the left tail suggests the model is correctly approximating the borrowing constraints firms face. The model, though, is not able to generate as much skewness as observed in the data.

From a quantitative standpoint, we find that investment demand plays an important role in generating positive net savings. Firms expecting high productivity in the next period have a high demand for finance. The large investment, though, also leaves them more exposed to a negative shock. By issuing additional equity, and saving the additional funds, the firm can effectively hedge against the investment risk.

We take now a closer look to the role of investment in the demand for equity and positive net savings. Consider a firm looking to finance investment k' and facing a simplified productivity process, with two possible shocks, $z = 0$ and $z = z^h$. Given choices for net savings and equity

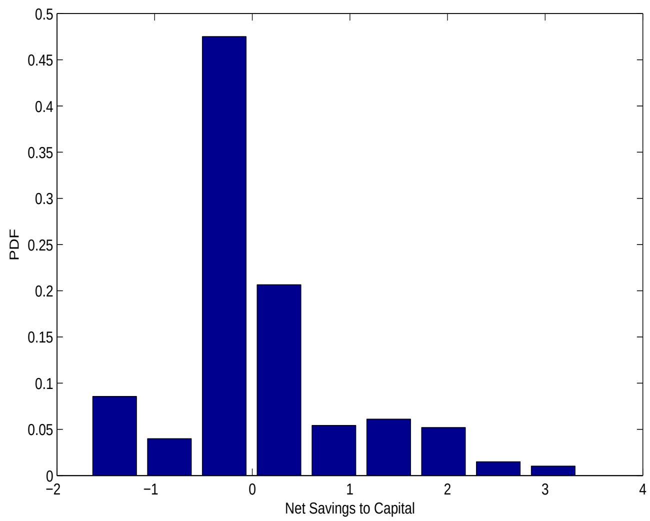

Figure 5: Net savings to capital density, model

a', s', the realizations of net worth are

$$\begin{aligned} \omega'(0) &= Ra', \\ \omega'(z^h) &= Ra' + (1-s')\pi(k', z^h). \end{aligned}$$

The first observation is that the spread between net worth realizations, and thus the risk, is larger the higher is investment,

$$\omega'(z^h) - \omega'(0) = (1-s')\pi(k', z^h).$$

Because of the concavity of V, the entrepreneur is willing to take a loss in expected return if it reduces the dispersion of net worth realizations. This can be achieved by raising one more dollar of equity and increasing net savings by the same amount. Since equity faces markdown $\xi < 1$, $E\{\omega'\}$ falls, but so does the risk

$$\frac{d\left[\omega'(z^h) - \omega'(0)\right]}{ds'} = -\pi(k', z^h).$$

The capital structure of the firm will be adjusted in this manner until the cost, due to a smaller expected return, and the gain, due to lower risk, are exactly equal. A simple heuristic argument highlights why firms with high investment will end up with high equity demand and positive net savings. The higher the investment, the larger the risk exposure (larger spread $\omega'(z^h) - \omega'(0)$). Thus the more the firm is willing to take in lower expected return in exchange for lower risk.

This logic highlights the idea, emphasized also by Hennessy and Whited (2005), that it is essential to view the capital structure decision in the context of a fully specified dynamic problem. Firms with a moderate level of net worth may have no chance of being at debt capacity *next* period or, more generally, in the short term. A model with a short horizon would need humongous cash flow shocks in order to induce demand for equity among firms with some net savings. In a fully forward looking model, even firms that can self-finance in the short-term strive to accumulate further net savings and value the insurance properties of equity.

7 What is behind the rise of corporate savings?

In this section we use our model to explore the factors behind the rise of corporate savings between 1970s and 2000s. We argue that the fall in effective dividend taxation, and the associated fall in the cost of equity relative to debt, has led to the observed increase in corporate net savings. Our hypothesis parallels the findings of McGrattan and Prescott (2005), who argue that changes in the U.S. tax and regulatory system can explain large movements in U.S. equity values relative to GDP during 1960-1990 period.[34] We recognize there are a number of factors affecting the costs and benefits of equity that are likely to have changed over time. However, as we did previously, we choose to focus on fiscal considerations which are relatively easy to quantify over time.

There is no question that dividend taxation has eased up over the past 40 years. The decline has been driven by: (i) a decline in marginal income tax rates; (ii) an increase in the share of equity held by fiduciary institutions who pay no taxes on dividend income or capital gains.[35]

To quantify the changes in taxation we rely on Poterba (1987), and set the dividend tax rate τ^d corresponding to 1970s at 0.28. Our baseline calibration for 2000s used a tax rate of $\tau^d = 0.15$. Thus according to our calibration, the decline in dividend taxation during 1980s and 1990s, up to the Jobs and Growth Tax Relief Reconciliation Act of 2003, halved the effective dividend tax rate. We recompute our markdown parameter with the higher tax rate, which renders equity more expensive relative to debt, $\xi = 0.69$. We keep all other parameters unchanged in order evaluate the role of taxation independently. With the 1970s calibration in hand we compute the industry equilibrium. This modified model produces a new distribution of net savings to capital, whose moments are summarized in Table 5.

Despite our parsimonious recalibration, we find that the model matches a number of data

[34] McGrattan and Prescott (2005) abstract from corporate finance decisions by assuming equity is the only source of financing for investment. It is thus an open question whether the fall in effective dividend taxes can explain the changes in the aggregate capital structure.

[35] See McGrattan and Prescott (2005) for a discussion of how changes in regulation have had an important impact on the effective marginal tax rates on U.S. corporate distributions.

	2000s		1970s	
netsav2k	Data	Model	Data	Model
mean	0.11	0.11	-0.12	-0.23
median	-0.05	-0.05	-0.18	-0.20
netsav2k > 0	41.44%	39%	25.42%	26%
skeweness	1.66	0.61	2.54	-1.26
std dev	0.72	0.89	0.43	0.67
10pct	-0.56	-0.67	-0.52	-1.46
25pct	-0.35	-0.10	-0.36	-0.21
75pct	0.32	0.11	0.00	0.01
90pct	1.09	1.43	0.28	0.56

Table 5: Model and Data — 1970s calibration

moments in the 1970s very well. In particular, it replicates the median net savings to capital and the share of firms with positive net savings almost exactly. It also delivers a very close match for the 25th and upper percentiles of net savings to capital distribution, as well as to its second moment. The model, however, overpredicts the amount of borrowing at the left tail of net savings to capital distribution, predicting a lower mean than that observed in the data.

We also verify the ability of the model to replicate the relationship of net savings with employment. In Figure 4 in the Data Section we showed that net savings to capital were decreasing in firm size in 2000s, but exhibited no association in the 1970s. Figure 6 presents the corresponding net savings-employment plots in the model. For the 2000s we calibrated the productivity process to replicate the decreasing relationship of net savings with size, so it is not surprising that the model matches it well. In the 1970s, however, we did not target any data moment, yet Figure 6 makes it clear that the model predicts no association between the two, as in the data.

It is worth noting that, despite the lower net savings, our calibration for 1970s features *tighter* borrowing constraints. While this conforms to our priors regarding financial innovations, we emphasize that we did not introduce any ad-hoc change in the borrowing constraints. Instead it is the higher cost of equity that endogenously implies a smaller debt capacity, as the ability of a firm to sustain a given level of debt is reduced the costlier are the alternative sources of finance.

Overall, our results suggest that a decline in dividend taxes and regulations over the past 40 years, goes a long way in explaining the rise of corporate net savings to capital in the U.S. during the same period.

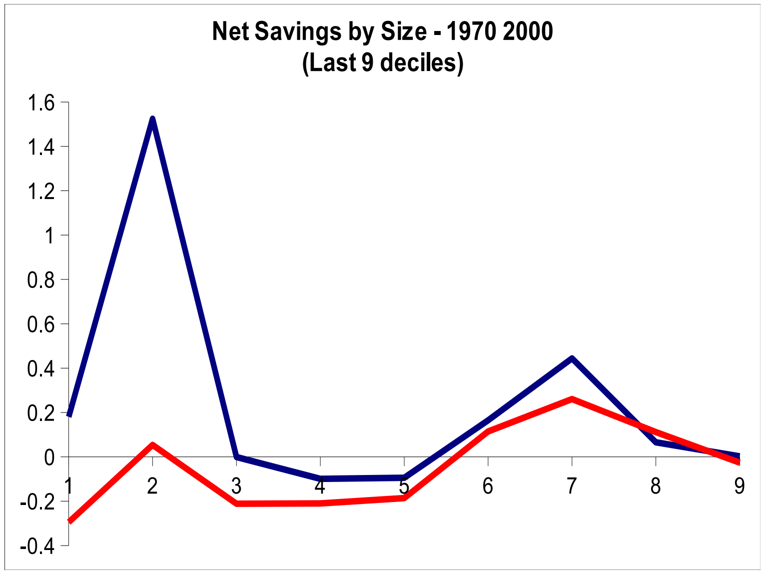

Figure 6: Net savings by size, Model

8 Conclusions

We started by documenting the switch in the net position from borrower to lender for the U.S. corporate sector over the period 1970-2007. We then put forward a model capable of explaining the simultaneous demand for equity and net savings, despite the fiscal advantages associated with debt. Our hypothesis emphasizes the risk considerations firm 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. We showed our model can match quantitatively the net lender position of the corporate sector for the period 2000-2007, and performs well in several dimensions. We then asked what is behind the rise in corporate savings since 1970, and found that the fall in dividend taxes appears to be the main culprit.

Going forward we have several questions in mind. First, we would like to set the changes in the saving behavior of the corporate sector in the broader perspective of the whole economy. For example, the rise of corporate savings broadly coincides with a fall in the personal savings rate for U.S. households and, more recently, with an increase in the current account deficit. How are these phenomena related? What are the implications for aggregate savings and investment?

We would also like to be more comprehensive regarding the costs and benefits of equity. We have taken a quite narrow view of the former by focusing exclusively on fiscal considerations. This allowed us to quantify the cost of equity independently. But no doubt there are other costs associated with equity, and it is possible that they have changed over the last 40 years as well.[36] Similarly, we have focused on our hypothesis regarding the demand of equity, and showed to be quantitatively capable of explaining the data. But there may be other important considerations in play. Perhaps paramount among them are liquidation risk and agency problems. We hope to be able to encompass several alternative theories of equity and debt in a general framework.

[36] Examples are: issuance cost, adverse selection, loss of control...

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Appendix

A Data

In this section we describe our data work in more details. Our firm-level analysis uses Compustat dataset for 1970-2007 period. As in Hennessy and Whited (2005), Gourio and Miao (2010) we use the following criteria to restrict our working sample. First, we focus only on US firms, whose capital is above 50,000 USD, and whose equity is non-negative. Second, we exclude firms who according to Standard Industry Classification (SIC) belong to finance, insurance and real estate sector (SIC classification is between 6000 and 6799); regulated utilities (SIC classification is between 4900 and 4999); information technology and telecommunication services firms (SIC classification of 7370-7379, 4800-4899, and 3570-3579).

If SIC classification is not available, we then use North American Industry Classification System (NAICS) to exclude the firms belonging to the above three industries. In particular, finance, insurance and real estate firms are identified as those under NAICS sector codes 52 and 53; utilities are those with NAICS sector code 22; while information technology and telecommunication services are identified with sector code 51. If SIC and NAICS classification code was missing, then we allocated the firm into sectors according to its Global Industry Classification Standard (GICS). Thus, we excluded firms with GICS classification of 40 (Financials); 55 (Utilities); 45 and 50 (Information Technology and Telecommunication Services, respectively).

We begin by summarizing the properties of aggregate net savings to capital ratio in the Compustat dataset. We construct net savings as the difference between financial assets and liabilities. Financial assets are comprised of cash and short-term investments, other current assets, and account receivables (trade and taxes). Liabilities are computed as the sum of debt in current (due within one year) liabilities and other current liabilities; long-term debt; and account payable (trade and taxes). Capital stock is obtained as the sum of firm's gross value of property, plant and equipment; its total investment and advances; unamortized value of intangible assets;

and total inventories. Equity is obtained as the value of common and preferred shockholders' equity. All our variables of interest are measured as a ratio of capital.

Next we discuss the levels and dynamics of net savings to capital ratio in Compustat and compare it with the aggregate Flow of Funds measure of net savings. The latter is summarized in Figure 1 in the main text. Figure A1 summarizes our findings in the Compustat data. It plots two ratios: the ratio of average net savings to average capital; and the ratio of median net savings to median capital. We must keep in mind that while the ratio of means gives us a measure of net savings to capital that is the closest to the Flow of Funds calculation, it also is heavily influenced by the outliers – firms with large capital and/or net savings.[37] It is easy to see from Figure A1 that these large firms are borrowing, on net, 25 percent of their capital, and that this level has remained relatively stable over time. Contrasting this with the Flow of Funds pattern for net savings suggests several possibilities. First, small and medium-sized firms in the Compustat are behind the rise of net savings. We verify this conjecture by looking at the median net savings to median capital, which allows us to control for the outliers in both variables. Indeed the ratio of medians exhibits a clear upward trend over time. Net savings are rising steadily over time, although they do not turn positive in the 2000s like the Flow of Funds series. Furthermore, when we explicitly contrast the levels of net savings to capital for small and medium-sized firms with those of the large firms (see Figure 4 in the main text), we find a clear support to the idea that small and medium-sized firms are responsible for the increase in net savings to capital over the past 40 years.

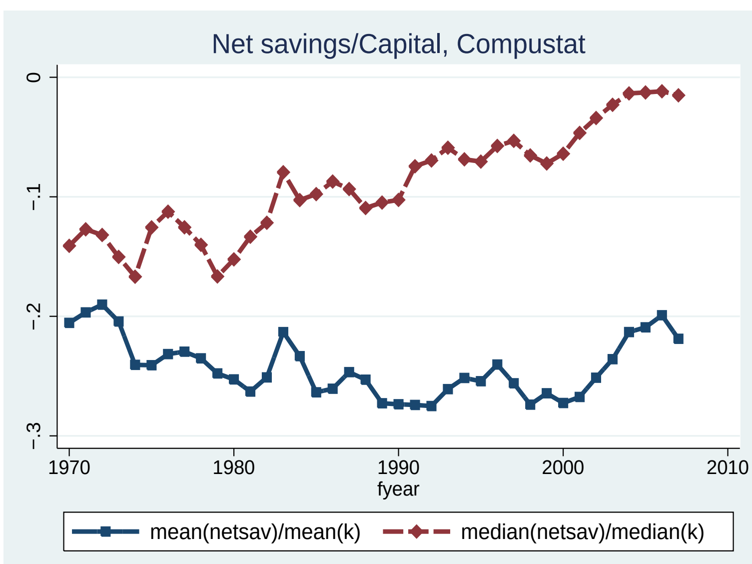
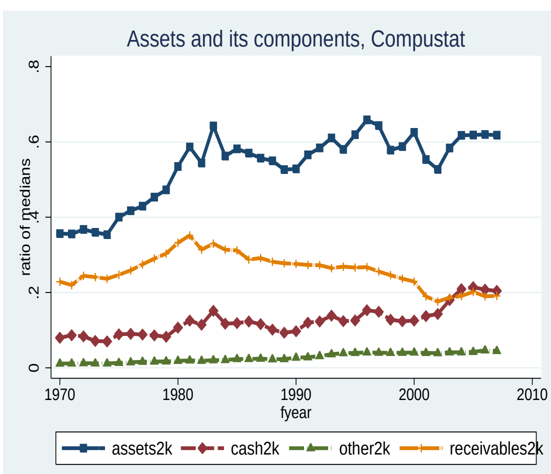


Figure A1: U.S. non-financial, non-utilities, non-technology corporate sector NS, share of K

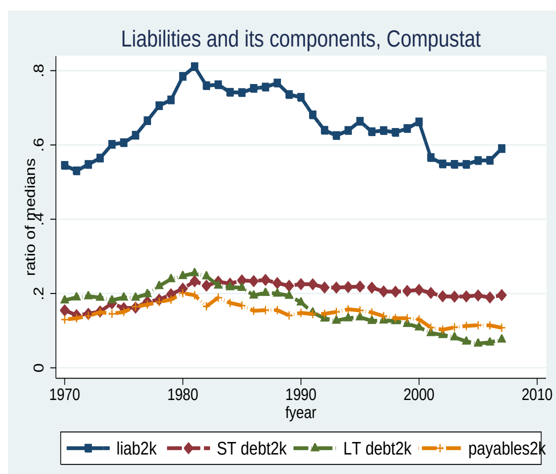
[37]For this reason, our preferred aggregate measure of net savings in the Compustat is the mean and median of the ratio, which we reported in Figure 2 in the main text.

Second possibility is that private firms, which are not in the Compustat, contribute to the increase in net savings to capital. The balance sheet data for private firms, however, is limited, but the recent work by Gao et al. (2010) suggests that these firms may not have contributed much to the rise in net savings to capital by U.S. corporate sector. While this work primarily concerns firms' cash holdings, rather then net savings, it is still informative since, as we show later, increase in cash holdings and other short-term investments contributed the most to the increase in net savings. Thus, Gao et al. (2010) using a sample of U.S. public and private firms during 2000-2008 period show that on average private firms hold less than half as much cash as public firms do.[38]

Next, we investigate the gross positions of the firms and their components. Our goal is to isolate the components of financial assets and liabilities that are behind the rise of net savings. Figure A2 shows our results. Panel (a) of that Figure presents 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 a ratio to median capital. From the Figures it is easy to see that both assets and liabilities are rising over time, but the increase in assets is more pronounced. Most of the rise in assets is due to higher cash and equivalent holdings of U.S. firms. Other asset categories have been going up as well, but at a much lower pace. Finally, account receivables have declined from about 28 percent of median capital level in the 1970s to less than 20 percent in the 2000s.



(a) Assets



(b) Liabilities

Figure A2: Gross positions and their components

[38]Niskanen and Steijvers (2010) using a sample of private family firms in Norway find that an increase in firm size is associated with a decrease in cash holdings, a feature that we also document for net savings in our dataset of public U.S. firms.

On the liability side, long-term debt and account payables have both fallen over time, while short-term debt showed a slight increase. Overall, these decompositions suggest a shift in firms' balance sheets away from long-term assets and liabilities towards their short-term counterparts; but with the share of account receivables and payables in the short-term assets and liabilities falling over time. In the model we do not distinguish the maturity structure of debt, and thus in what follows we focus on the overall net assets position.

Who are the firms behind the rise in corporate next savings? We turn to this question next and study net savings positions conditional on firm industry, size, age and entry cohort. Figure A3 plots the ratio of median net savings to median capital in six industries: Agriculture and Mining; Manufacturing; Trade, Transportation and Warehousing; Services; Construction; and Information Technology and Telecommunication Services.[39] Several notable feature of the data stand out. First, the increase in net savings to capital is characteristics of all industries, with the exception of construction, which shows a clear break in the series in the late 1980s. However, we have very few observations for this industry and thus do not argue this is a robust finding. Technology sector, on the other hand, shows the most pronounced increase in net savings over our sample period. In fact, this sector has turned into a net lender in the early 1990s and continued to accumulate net savings ever since. Therefore, developments in the technology sector could have contributed to the run-up in aggregate net savings observed in the Flow of Funds series, especially in the 1990s.

Second, there is some heterogeneity in the level of net savings to capital across industries. For instance, firms in Trade, Transportation and Warehousing industry have consistently had the lowest level of net savings to capital during 1970-2007 period. Technology sector was characterized by the lowest level of net savings to capital in the early 1970s, but as discussed above, this has clearly changed in the past 30 years. Finally, agriculture and mining, manufacturing, and services, all have very similar levels and dynamics in net savings to capital ratio over our sample period.

Overall, these results suggest that while some of the increase in net savings to capital ratio over time could be attributed to changes in the industrial structure of the U.S. economy (i.e. expansion of the technology sector), the rise of corporate savings is characteristic of all industries.

Next we turn to firm-level characteristics and relate them to the rise in net savings. First, we study net savings for the firms of different size, as measured by their employment level. Figure 4 in the text reports the median net savings to capital ratio for different employment percentiles, separately for 1970s and 2000s. It is easy to see that firms of all sizes were net borrowers in the 1970s. In the 2000s the relationship between net savings to capital ratio and employment became clearly decreasing, with smaller and medium size firms turning into net

[39]As mentioned earlier Technology sector is excluded from our benchmark sample. We include it here for illustration purposes.

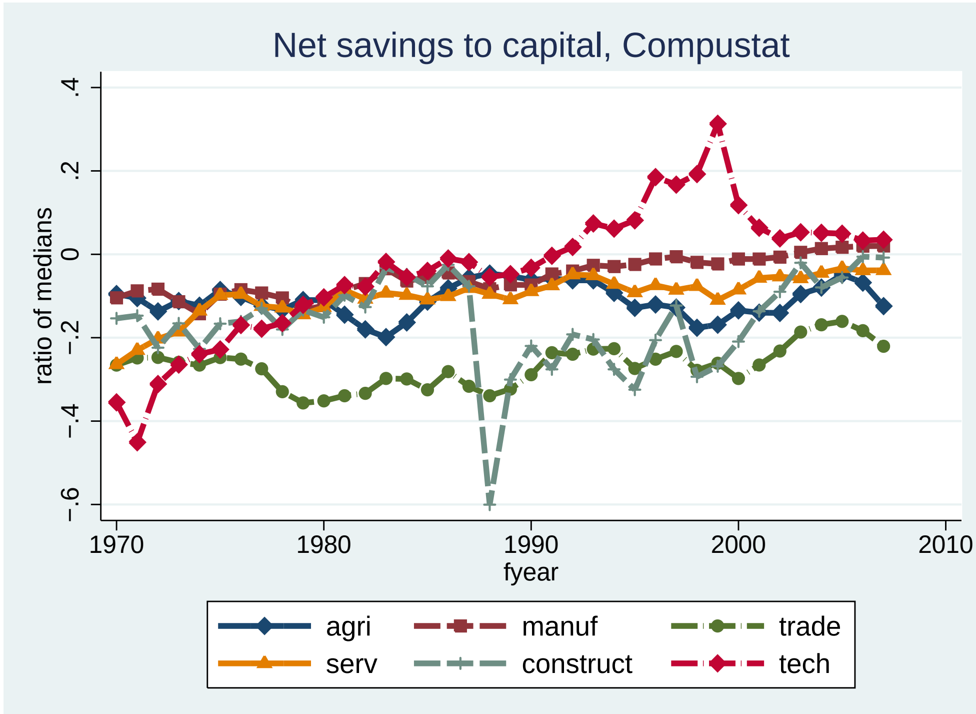


Figure A3: U.S. corporate sector NS by industry, share of K

creditors in that decade. At the same time, larger firms, while increased their net savings a bit, have remained net debtors. Similar pattern applies at the industry level as well, especially for firms in manufacturing, services, and construction. The increase experienced by agriculture and mining firms, as well as the firms in trade, transportation and warehousing is characteristic of all firms in their respective industries, but is much more muted.[40]

Second, we study net savings to capital separately for entrants into the Compustat and incumbents for each decade. Table A1 summarizes mean and median of net saving to capital for entrants and incumbents over the last four decades. A firm is defined as an entrant in a given decade if it appeared in the Compustat in any year of that decade.

Table A1: Net savings to capital: entrants and incumbents

	Entrants		Incumbents	
	mean (i)	median (ii)	mean (iii)	median (iv)
1970s	-0.0350	-0.1908	-0.1296	-0.1596
1980s	0.5940	-0.1172	0.0076	-0.1691
1990s	1.1371	-0.0483	0.0994	-0.1491
2000s	4.3390	-0.0501	0.5289	-0.0918

[40]These results are available from the authors upon request.

Our results indicate that entrants tend to have higher net savings to capital ratios relative to incumbents, and that this tendency has become more pronounced over time.[41] Majority of the differential in net savings to capital ratio between incumbents and entrants is due to the larger cash holdings and short-term investments of the latter. Over time, both cohorts have increased their holdings of cash and short-term investments, but entrants have done so at a significantly faster pace.[42]

Are the differences between entrant and incumbent firms all due to their age differential, or is there an independent cohort effect? We find that median net savings to capital show no significant association with age. Mean net savings to capital are more sensitive to age, with older firms saving less. However, the cohort effect remains significant.

Finally, we investigate the role of all the factors discussed above jointly through a panel regression. In our benchmark specifications that pools firms in Compustat during 1970-2007 period, we find that after accounting for employment, age, as well as industry and cohort fixed effects, net savings to capital have increased over time and significantly so.[43]

B Model

B.1 Feasible investment

We first focus on the set of feasible investment choices, $\Gamma(\omega, z)$, for any given values for α and ω^b. Given a choice of investment k', there are enough resources to ensure non-negative consumption if and only if

$$\omega + p(k', z) + \alpha \geq +k', \tag{A1}$$

that is, net worth, plus maximum equity issuance $s' = 1$ and debt $a' = -\alpha$, are sufficient to finance investment. The set $\Gamma(\omega, z) \subset \Re_+$ is thus all the investment k' such that (A1) is satisfied for given values of ω and z.

To characterize the set, let

$$\psi(k', z) \equiv p(k', z) - k'.$$

This is the maximum amount of equity funds available, net of investment. It can possibly be negative if the firm is not able to raise enough equity to finance all investment. We can then re-write (A1) as

$$\omega + \psi(k', z) \geq -\alpha. \tag{A2}$$

[41]Only in the 1970s median net savings to capital ratio for entrants is somewhat below that for incumbents.

[42]These results are available from the authors upon request.

[43]The time effects remains positive and significant for 2000s but not for 1980s and 1970s when we include firm-level fixed effects in the panel regression. These results, as well as all other results that are discussed but are not formally presented in the paper are available from the authors upon request.

Function $\psi(k', z)$ is not monotone in k'. It is easy to check that $\psi(0, z) = 0$, $\psi(k', z)$ is increasing at first with k' and has a maximum at point $\tilde{k}(z) > 0$ where

$$p_k\left(\tilde{k}(z), z\right) = 1.$$

Function $\psi(k', z)$ decreases from then on, eventually crossing again zero. Thus we can characterize the set of feasible investments as

$$\Gamma(\omega, z) = \left\{k' \geq 0 : \psi(k', z) \geq -\alpha - w\omega\right\}.$$

Thus the set $\Gamma(\omega, z)$ is a closed interval, which guarantees that $\Gamma(w, z)$ is convex and compact, and the resulting recursive problem is well-behaved. However, for arbitrary choice of α and ω^b, the set may be empty. We ensure there is always a feasible level of investment in the next subsection.

B.2 No default condition

We now derive the value of α that ensures there is no default with probability 1. This is equivalent to say that at all times there is a feasible level of investment compatible with non-negative consumption—that is, $\Gamma(\omega, z)$ is not empty. Clearly $\Gamma(\omega, z) \subset \Gamma(\omega', z)$ if $\omega < \omega'$ and $\Gamma(\omega, z) \neq \emptyset$. We thus evaluate $\Gamma(\omega, z)$ at the lower bound ω^b. Clearly $\Gamma(\omega^b, z)$ is not empty if

$$\max_{k' \geq 0} \psi(k', z) \geq -\alpha - \omega^b.$$

The right hand side does not depend on the state, thus a sufficient condition for $\Gamma(\omega^b, z)$ to be non-empty at all states is that

$$\bar{\psi} \equiv \min_{z \in Z} \max_{k' \geq 0} \psi(k', z) \geq -\alpha - \omega^b. \tag{A3}$$

Note this is only saying that the firm must be able to raise enough equity and debt, net of investment, to finance its negative net worth position.

Recall that the lower bound ω^b is achieved at $-\kappa - R\alpha$. Evaluating (A3) with equality, and substituting for the lower bound, we obtain

$$\alpha = \frac{\bar{\psi} - \kappa}{R - 1}.$$

It is, of course, possible to set the borrowing constraint at arbitrary values lower than α and there would be no default with probability 1.