Firm Financing over the Business Cycle

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Abstract

In the data, large public firms substitute between debt- and equity financing over the business cycle whereas small firms' financing policy is pro-cyclical for debt and equity. This paper proposes a mechanism that explains these cyclical patterns. Small firms grow faster and need therefore more funds compared to large firms. During times with high aggregate productivity, they quickly exhaust their endogenous debt limit and must turn to equity financing. In contrast, large firms are close to their efficient scale and want to payout to shareholders. Good times lower the probability of default, decreasing the costs of debt financing for large firms with more collateral. This makes debt financed payouts to shareholders attractive. We embed this mechanism in a quantitative firm industry model with endogenous firm dynamics and explore how macroeconomic shocks get amplified.

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1 Introduction

Disruptions in macroeconomic and financial market conditions have large and persistent effects on non-financial firms both in terms of their financing (e.g. Hackbarth, Miao, and Morellec (2006)) and investment decisions affecting the real economy (e.g. Jermann and Quadrini (2012)). In a world where the Modigliani-Miller (MM) theorem holds, investment decisions are independent from financing choices. With financial frictions however, firms must jointly choose investment and financing policies in order to maximize firm value, potentially amplifying aggregate shocks (Bernanke and Gertler (1989)). Covas and Den Haan (2011) document that large public firms substitute between debt- and equity financing over the business cycle whereas small firms' financing policy is pro-cyclical for debt and equity. Based on our definition, the vast majority of firms, that is at least 75 percent of the Compustat universe, classify as small firms. The mechanism through which aggregate shocks and financial frictions generate differences in firm financing behavior is still unknown.

In this paper, we propose a mechanism that generates these cross-sectional financing differences over the business cycle and explains why the bottom 75 percentile of firms behaves so differently from the top 25 percentile of firms. In a nutshell, we explain business cycle differences in firm financing behavior with differences in funding needs and financial frictions. We embed this mechanism in a quantitative firm industry model with endogenous firm dynamics and explore quantitatively how the frictions in the model help generate the differences in financing behavior between the bottom 75 percentile of and the top quartile of Compustat firms. We find that our model accounts quantitatively for the cross-sectional differences in firm financing behavior that we see in the data.

We document an empirical fact similar to Covas and Den Haan (2011) who first made the point on the cross-sectional differences in firm financing behavior over the business cycle using annual Compustat data. Instead, we focus on quarterly firm level data from Compustat, that allow us to compare our results with aggregate studies on business cycle fluctuations. External financing comes either from debt- or equity holders. Therefore, we define two financing variables, equity payout and debt repurchase, that describe all funds an investor receives from the firm. These definitions are based on cash flow variables in Compustat that represent a comprehensive measure of firms' external financing.

Sorting firms based on their sector specific asset positions into four size portfolios, we document that firms in the bottom three-quartiles of the asset size distribution finance procyclically with both debt and equity. In contrast, firms in the top quartile substitute debt and equity financing over the cycle. The pattern in the data suggests that large firms finance equity payout in booms with debt. The behavior of large Compustat firms is identical to the behavior of aggregate Flow of Funds data as documented by Jermann and Quadrini (2012). When we aggregate the positions across size portfolios, it becomes clear that Flow of Funds data is dominated by the behaviour of the large firms.

In booms small firms increase total external financing whereas in recessions total external financing is reduced. Moreover on average, small firms obtain more funds through equity than through debt financing. Our interpretation of this fact is that small firms find debt financing too costly, motivating them to turn to equity. Finally we also study sales growth of small versus large firm portfolios. It shows that small firms display higher growth rates on average than large firms. This is intuitive because most small firms in Compustat are young firms with respect to their age since IPO; they went public to obtain capital for growth.

This paper proposes a model with heterogeneous firms facing aggregate and idiosyncratic shocks and endogenous firm dynamics. Firms need to make investment and financing decisions, most notably whether to finance investment or payout to shareholders with debt and/or equity. The decreasing returns to scale production technology allows us to study firm dynamics with entry and exit. Moreover, this assumption generate patterns of investment that are negatively correlated with firm size. Adjustments to capital are subject to adjustment costs which we introduce to generate slow convergence to the efficient scale. Each period potential entrants receive a signal about their future productivity and decide whether to enter. Entrants are typically small in terms of size. Endogenous entry is important to allow for time variation in the number and size of entrants. When firms enter small, decreasing returns to scale mean that firms are far away from their efficient scale.

While making the capital structure choice firms face the following trade-offs. Debt is preferred over equity because of the tax advantage of debt. At the same time, debt financing is costly because debt repayment is not enforceable. The price of debt adjusts to reflect the likelihood of default. The default decision depends on the firm's internal funds, the debt that it needs to repay as well as on the shocks. Given the shocks and the loan amounts, it is more costly for small firms than for large firms to issue debt because their default probability is higher. We subject equity financing to linear adjustment costs. The objective of firms is to maximize equity payout.

The model is parametrized to the world of U.S. publicly listed firms. Because our interest is on the cross sectional financing behavior, we focus on the entire firm size distribution instead of on an individual firm. Due to entry and exit, the firm size distribution is endogenous and business cycle dependent. As in the data the definition of small and larger firm is also endogenous and shock dependent.

The quantitative results show that frictions affect firms financing and investing decisions differently depending on their size. Next, we use this framework to understand how aggregate shocks are amplified. Because all but the top 25 percentile firm size do not substitute across the two types of external financing when a negative aggregate shock hits, those firms that are constrained have to change their investment decisions significantly. We show that relative to a frictionless model, our model generates a 2% higher amplification of shocks. The next paragraph describes the main mechanism in detail.

Mechanism for the cross-sectional differences in financing

We illustrate our mechanism in a two period model with a unit mass of firms. That is, we isolate the forces that lead to differences in financing behavior for small and large firms over the business cycle.

In the two period model, each firm is indexed by i. It owns a decreasing returns to scale technology in capital $k_{t,i}$ to produce revenue in period 0 and period 1. In each period, the production technology of all firms is hit by an aggregate shock, z_0 and z_1 respectively. The shocks follow a 2-state Markov chain with probabilities:

Prob	$z_1 = \text{L}$	$z_1 = \text{H}$
$z_0 = \text{L}\,\vert$	π_L	$1-\pi_L$
$z_0 = \text{H}\,\vert$	$1-\pi_H$	π_{H}

Each firm individually is also hit by an idiosyncratic cost shock s_i that is*iid* across firms, independent of z, and follows a uniform distribution: $s \sim U(0, \bar{s})$. In period 0, each firm is endowed with an initial capital stock $k_{0,i}$ and needs to decide its next period's capital stock $k_{1,i}$. It can use the after-tax proceeds from their operations together with the proceeds from raising debt b_i at the price of $q(k_{1,i}, b_i)$ to fund investment $k_{1,i} - (1-\delta)k_0$ and pay investment adjustment costs $c_0 k_{0,i} + \frac{c_1}{2}\left(\frac{k_{1,i}-(1-\delta)k_{0,i}}{k_{0,i}}\right)^2 k_{0,i}$. The firm's payout to shareholders are

$$d_{0,i} = (1-\tau_c)\, z_0 k_{0,i}^{\alpha} - (k_{1,i} - (1-\delta)\, k_{0,i}) - c_0 k_{0,i} - \frac{c_1}{2}\left(\frac{k_{1,i} - (1-\delta)k_{0,i}}{k_{0,i}}\right)^2 k_{0,i} + q(k_{1,i}, b_i)\, b_i - c_f.$$

The firm needs to pay an equity issuance cost $\Lambda(d_{0,i})$ that is proportional to equity payout if $d_{0,i} < 0$

$$\Lambda(d_{0,i}) = 1_{d_{0,i}<0}(\lambda\, d_{0,i}).$$

In period 1 the payout to shareholder equals

$$d_{1,i} = (1-\tau_c)\, z_1 k_{1,i}^{\alpha} + (1-\delta(1-\tau_c))\, k_{1,i} - (1-\tau_C r)\, b_i - s_i - c_f.$$

That is the after tax revenue plus depreciated capital less debt repayment less the realization of the idiosyncratic value shock, s_i. In period 1, depending on the realization of the shock, firms decide whether to default or not. If $\bar{d_{1,i}} < 0$, the firm defaults. Summarizing, the problem of an individual firm with initial capital stock $k_{0,i}$ is to maximize the discounted sum of equity payout:

$$V(k_{0,i}) = \max_{k_{i,1}, b_i, \text{default}} d_{0,i} + \Lambda(d_{0,i}) + \beta E_0 \max(0, d_{1,i}).$$

Given an initial capital stock k_0, all firms are ex-ante identical. The price of the debt in period 0 is set such that an risk-neutral investor is indifferent between investing in a risk free and the risky bond:

$$1 + r = \left(1 + r^b\right) \text{Prob}(\text{default}) + (1 - \xi)(1 - \text{Prob}(\text{default})) \frac{((1 - \delta) k - c_f)}{b},$$

where ξ is the bankruptcy cost. That is with $\xi = 1$, all is lost in case of default. Otherwise debtholders can recuperate the residual value. Defining $q \equiv \frac{1}{1+r^b}$, we can solve for the bond price as:

$$q(k, b) = \frac{\text{Prob}(\text{default})}{1 + r - (1 - \text{Prob}(\text{default}))(1 - \xi) \frac{((1-\delta)k - c_f)}{b}}.$$

We can solve this model analytically for a given initial capital stock level, k_0, and for an initial aggregate state z_0. The details of the two-period model are in the appendix section (A).

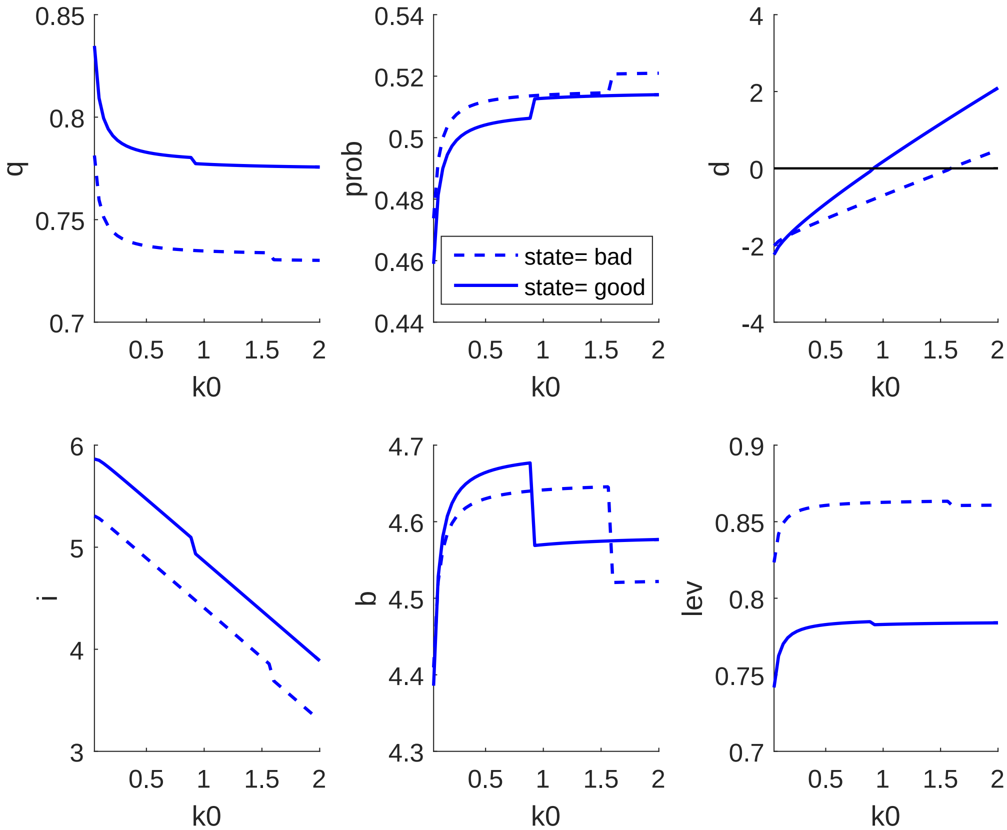
Main Mechanism We can illustrate the main mechanism of the general model with its two-period version. The question is how firm size affects firms' optimal decisions. Figure 1 presents how the model's key variables change when we vary the size of the firm. The key variables are the price of debt q, the probability of default, equity payout d, investment i, debt issuance b, and leverage lev change.[1] The production technology features decreasing returns to scale and therefore an optimal scale given the productivity level. However, the presence of capital adjustment costs hinders firms to adjust their capital stock quickly to their optimal size. In this example, all firms have identicals optimal scales. A smaller firm is therefore farther away from its optimal size[2], implying a higher return on investment. The

[1] The parameter values for Figure 1 are as follows:

z	0.5 2.5	λ	0.05	δ	0.025
π_L	0.8	ξ	0	τ_c	0.4
π_H	0.05	c_f	0.002	β	$\frac{1}{1+r}$
α	0.7	c_1	0.00065	$\bar{s}$	5

[2] Adjustment costs punish small firms more for a unit of investment, generating non-linearities and non-monotonicity in the choices.

Figure 1: Main Mechanism



growth option embedded in small firms' capital investments generates a higher return than the return shareholders would receive if the firm were to distributed its current revenue[3]. Thus, investing into the capital stock of growing small firms is attractive, generating small firms' higher funding needs.

Firms finance investment with internal funds and both debt and equity. Equity issuance is subject to a linear cost. The choice of debt financing is determined by trading-off the tax-advantage of debt against the bankruptcy cost in case of default, when bondholders can only recuperate a fraction of the remaining firm's value due to bankruptcy costs, making debt risky. For this reason, debt is issued at a premium which is higher for firms with low collateral and a high likelihood of default. The endogenous bond price limits the amount of funds $q\,b$ firms can raise with debt, generating an endogenous debt ceiling. The ceiling can become binding when a firm's funding needs exceed its debt funding cost.

Figure 1 shows how all this gets together. The probability of default (upper middle graph) is positive and larger in bad states of the world (dashed line) compared to good

[3] Shareholders are sufficiently patient to wait for larger payouts in the future when the firm has attained its efficient scale.

states of the world (solid line). Hence, the price of debt must be larger in good states of the world (upper left graph). Since small firms' return on capital is higher, they want to invest more (lower left graph) and more so during booms. This increases small firms' funding needs, requiring both debt and equity financing. Small firms issue equity to fund themselves and more so during booms (solid line) but investment needs are higher during booms. In contrast large firms have lower investment needs (see lower left graph) and therefore lower funding needs. They increase equity payout during booms. A boom increases the marginal benefit of investment and lowers the endogenous borrowing constraint for all firms, leading to counter-cyclical debt repurchases. Moreover, equity funding becomes more attractive for small firms, while equity payout easier for large firms (because of higher internal funds). This generates pro-cyclical equity payout for large firms and counter-cyclical equity payout for small firms. Large firms and small firms increase debt financing during booms but for different reasons. Large firms want to payout (see upper right graph) while small firms need to raise equity financing.

Related Literature

Firms' financial positions are important for understanding business cycle fluctuations. In the presence of financial frictions, they amplify the effects of productivity shocks (e.g. Bernanke and Gertler (1989), Carlstrom and Fuerst (1997), and Kiyotaki and Moore (1997)) by altering firms' investment behavior. In finance, the literature investigates what determines firms' financial positions and what matters for matching them quantitatively. For example, Hennessy and Whited (2005) and Strebulaev (2007) show that dynamic trade-off models rationalize the behavior of corporate financial data[4]. Gomes (2001) builds a theory to study the effects of firms' investment and financing behavior to shed light on the importance of financial frictions for firms.

Macroeconomic shocks are important determinants of firms' capital structure choice (e.g. Korajczyk and Levy (2003), Jermann and Quadrini (2006), and Dittmar and Dittmar (2008)). Jermann and Quadrini (2012) build a theory to show that financial shocks (in addition to productivity shocks and financial frictions) are necessary to rationalize cyclical external financing choices. Hackbarth, Miao, and Morellec (2006) build a quantitative model of firms' capital structure in which financing decisions depend on the business cycle through its effect on default policies. Our paper is different because we focus on the heterogeneous effects of macroeconomic shocks.

The fact that different firms react differently to aggregate shocks has been widely doc-

[4] An excellent overview over two decades of research in dynamic corporate finance is provided by Strebulaev and Whited (2012).

umented, see for example Korajczyk and Levy (2003)[5]. Covas and Den Haan (2011) show that the largest firms dominate the cyclical behavior of aggregate flow of funds data - as used in Jermann and Quadrini (2012). They find that equity issuance is pro-cyclical except for the largest firms and debt issuance counter-cyclical. We present similar business cycle facts using quarterly Compustat data.

Our firm industry equilibrium is based on Hopenhayn (1992) in which entry and exit are modeled similar to Clementi and Palazzo (2013). Hennessy and Whited (2007) estimate a simulated dynamic model based on Gomes (2001) to infer the costs of external financing. They find that the costs of external financing differs mostly between small and large firms. We base our choice of size as the essential dimension of heterogeneity on their analysis.

Our paper relates to a recent strand of papers that embeds a quantitative asset pricing models into a heterogeneous firm models with a dynamic capital structure choice (as in Hackbarth, Miao, and Morellec (2006)) to study how credit spreads and the equity premium get determined (e.g. Bhamra, Kuehn, and Strebulaev (2010a), Belo, Lin, and Yang (2014), and Gomes and Schmid (2012)). In these papers, firm size is oftentimes fixed after entry and therefore not used as a dimension of heterogeneity as in this paper. Our focus is on the business cycle flow of financial positions rather than prices. Covas and Den Haan (2012) share our focus and generate pro-cyclical equity issuance with exogenous, counter-cyclical equity issuance costs. Our model generates pro-cyclical equity financing for all but the largest firms with a mechanism: endogenous default and endogenous firm dynamics.

We join a growing literature that study the effects of endogenous firm dynamics and its interplay with financial frictions (e.g. Cooley and Quadrini (2001)) and the transmission of aggregate shocks (e.g. Bergin et al. (2014) and Clementi, Khan, Palazzo, and Thomas (2014a)). Our model allows us to study the role of firm dynamics, financial frictions, and aggregate shocks for firms' choice between equity and debt financing and the transmission of aggregate shocks. Firm dynamics are important because they determine funding needs and therefore the financing needs of firms. Understanding these relationships can improve our understanding about how aggregate shocks affect firms financing decisions and how shocks get amplified.

The paper is structure as follows. Section 2 presents the stylized fact on firm financing over the business cycle. Section 3 describes the firm optimization model defines the stationary firm distribution. Section 4 describes the parametrization strategy. Section 5.1 explains the mechanism behind the results presented in section 5.2.

[5]The results of Korajczyk and Levy (2003) and Jermann and Quadrini (2006) are inconsistent. Please refer to the discussion in Covas and Den Haan (2011) who show how aggregate data can lead to non-robust results.

2 Stylized facts

In this section, we document important stylized facts about the cross-section of public firms that motivate the heterogeneous firm financing model presented in this paper.

The main stylized fact is that small firms issue more debt and equity in booms whereas large firms issue more debt in booms and more equity in recessions. We use quarterly Compustat data from 1984-2014. A similar empirical analysis has been conducted by Covas and Den Haan (2011) that arrives at a similar conclusion. Using a book-value measure for equity and *annual* Compustat data up to 2006, they find that all but the top 1 percentile of the asset distribution have counter-cyclical equity payout and counter-cyclical debt repurchase.

2.1 Data

We use data[6] from CRSP/Compustat Merged (CCM) Fundamentals Quarterly from the first quarter of 1984 to the last quarter of 2014. The Compustat data set is the most comprehensive with financial firm-level data available over a long time span. Moreover, Compustat firms cover a large part of the US economy. We choose to focus on the period after 1984 to be consistent with the quantitative business cycle literature.[7]

Sample Description

We begin by reporting several facts about the sample that are informative about the nature of firm dynamics. We will use these facts to compare our model to the data. Figure 2 presents the density of logged assets, which approximately follows a log-normal distribution, except for the tails.

In the model, we will focus on firm size as a dimension of heterogeneity because external financing costs differ mostly by size (see Hennessy and Whited (2007)). Hence, we build size portfolios by sorting firms into quarter and sector specific asset quartiles, in other words bins. The composition of firms may therefore change from one quarter to the other. Table 1 presents the transition probabilities from moving from one bin size to another over a quarter.[8] The transition probabilities are fairly symmetric and indicate a higher (per quarter) chance for a small firm to move across bins than for large firm.

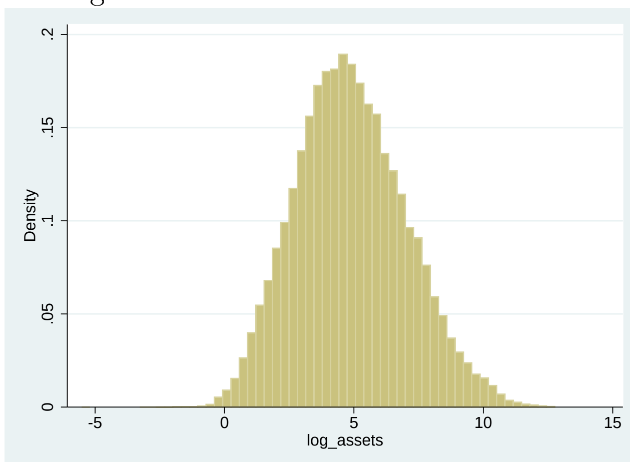
Variable Definitions

[6] The sample selection is described in section B.

[7] Jermann and Quadrini (2006) also show that the period after 1984 saw major changes in the U.S. financial markets.

[8] The appendix (see section B) contains more information on the panel characterstics of the sample.

Figure 2: Firm Size Distribution Data



This graph presents the kernel density of logged assets.

Table 1: Transition Probabilities

Asset Percentile	0-25%	25-50%	50-75%	75-100%
0-25%	96.02	3.93	0.04	0.00
25-50%	3.66	92.22	4.09	0.03
50-75%	0.02	3.20	94.08	2.71
75-100%	0.00	0.01	2.04	97.95

We use data on real quarterly GDP and the price level from NIPA. For the financial variables, we focus on funds obtained by firms from all available external sources: debt- and equity. In particular, we consider quarterly cash flows that flow between investors and firms. In defining the two financial variables, we take the perspective of a debt and equity holder and ask what are the cash flows she receives when investing in the firm.

An equity holder has a claim to the cash flow of a firm in the form of *equity payout*, which is defined as the sum of cash dividends and equity repurchases less equity issuance. Since firms may simultaneously (within a quarter) issue and repurchase we can look at the net equity repurchase position. Cash dividends (dvy) represent the total amount of cash dividends paid for common capital, preferred capital and other share capital. Equity repurchases (prstkcy) are defined as any use of funds which decrease common and or preferred stock. Equity issuances (sstky) are all funds received from the issuance of common and preferred stock. This variable includes the exercise of stock options or warrants for employee compensation as well as stocks issued for an acquisition. For this reason, the Compustat variable sstky may overstate equity issuances for financing reasons. We address this concern by adjusting the Compustat variable sstky according to the procedure suggested by McKeon (2013).[9]

These variables are stated as year-to-date. We convert them into quarterly frequency by subtracting the past quarter from the current observation for all but the first quarter[10] of the firm.

We define *debt repurchases* as the funds debt holders receive from their claim on a firm. More precisely, debt repurchases are defined as the negative sum of the change in long (dlttq) and short term (dlcq) debt. In Compustat, long term debt comprises debt obligations that are due more than one year from the company's balance sheet date. Debt obligations include long term lease obligations, industrial revenue bonds, advances to finance construction, loans on insurance policies, and all obligations that require interest payments. Short term debt is defined as the the sum of long term debt due in one year and short term borrowings. Equity payout and debt repurchase are defined for each firm-quarter observation.

We compute the financial variables equity payout and debt repurchases at the bin level. The correlation statistics are constructed by applying the band-pass filter to the deflated bin variable and scaling it by the trend component of assets, where assets have been aggregated

[9]McKeon (2013) shows how following his data adjustment corrects for compensation based equity issuance. He finds that equity issuance that are larger than 3% of total market value are almost certainly firm initiated while issuances between 2% to 3% of market capitalization are predominantly firm initiated. Therefore, we consider only equity issuance that are larger than 2% of market value. The results are virtually unchanged if we focus only on issuance larger than 3% of market value.

[10]Since the year-to-date variables are defined over the fiscal year of a firm we use the fiscal quarter definition in the conversion from year-to-date to quarterly variables.

Table 2: Business Cycle Correlation of Equity Payout and Debt Repurchases

Asset Percentile	Equity Payout	Debt Repurchases
0-25%	**−0.22**	**−0.50**
25-50%	**−0.18**	**−0.70**
50-75%	−0.03	**−0.60**
75-100%	**0.73**	**−0.68**
Aggregate	**0.69**	**−0.70**

We compute the correlations of quarterly real GDP with the deflated band-passed filtered components of equity payout and debt repurchases, scaled by the trend of assets. The numbers in bold are significant at the 5% level. Sample: Compustat 1984q1- 2014q4

to the specific bin level. For means and pictures, we use the seasonally smoothed variables and scale it by assets.

2.2 Stylized Facts of Firms' External Financing Patterns

Equity payout and debt repurchases over the business cycle

Table 2 documents the facts on the business cycle correlations of financial variables across firm size bins and on the aggregate level for comparison. The substitutability between debt and equity financing over the business cycle is displayed by the largest firms but not by the smaller firms. The correlations for the aggregate level are very similar to the top quartile of firms.[11] In the appendix section B we present how other financing variables such as cash, dividends (included in payout etc), and so forth differ over the business cycle.

The cyclical financing patterns are not just different by size, but also Tobin's Q as we show in Table 3. This table presents similar facts to Table 2 but sorts firms into both a portfolio based on size and on Tobin's Q. Moving across columns keeps Tobin's Q constant and changes asset size, while moving across rows varies Tobin's Q and fixes asset size. The table shows that procyclical equity payout is particularly strong for large firms with low Tobin's Q. The use of both forms of external financing sources in booms is particularly strong for small firms with high Tobin's Q. In the appendix section B, we also show how the external financing behavior changes with firms of different ages. Young firms behave very similar to small firms here. That is, either size, age, or Tobin's Q capture how firms' financing behavior differs but for comparability with the literature, we focus on size here

[11]Though these results are very similar to Covas and Den Haan (2011), we find that the substitutability between equity and debt financing over the business cycle matters for the top size quartile not just the top 1% largest firms as in their analysis. However, the fact that Covas and Den Haan (2011) compute their statistics for annual data whereas we compute the correlations for quarterly data makes it hard to directly compare our numbers.

Table 3: Business Cycle Correlations: Debt Repurchase

	Assets				
Tobin's Q	0-25%	25-50%	50-75%	75-100%	Agg.
0-25%	**−0.22**	**−0.22**	**−0.17**	−0.03	−0.03
25-50%	**−0.36**	**−0.54**	**−0.33**	−0.00	−0.02
50-75%	**−0.44**	**−0.45**	**−0.20**	**−0.40**	**−0.42**
75-100%	**−0.25**	**−0.40**	**−0.56**	**−0.31**	**−0.33**
Agg.	**−0.50**	**−0.69**	**−0.60**	**−0.69**	**−0.70**

Units: correaltion with GDP; Columns: firms sorted according to industry specific asset percentiles. Rows: percentiles in terms of industry specific Tobin's Q.

Table 4: Business Cycle Correlations: Equity Payout

	Assets				
Tobin's Q	0-25%	25-50%	50-75%	75-100%	Agg.
0-25%	−0.13	**0.27**	**0.37**	**0.60**	**0.62**
25-50%	−0.10	−0.04	**0.30**	**0.63**	**0.64**
50-75%	**−0.23**	−0.17	**0.27**	**0.67**	**0.67**
75-100%	**−0.22**	**−0.18**	−0.12	**0.32**	**0.26**
Agg.	**−0.23**	**−0.18**	0.03	**0.73**	**0.69**

Units: correaltion with GDP; Columns: firms sorted according to industry specific asset percentiles. Rows: percentiles in terms of industry specific Tobin's Q.

Table 5: Debt issuance & equity payout incidence

	Freq. of debt or equity fin. activity	Fin. activity with debt isss. & equity payout	Fin. activity with debt isss. & ex-div equity payout
mean	0.39	0.20	0.10
25%tile	0.30	0.00	0.00
50%tile	0.42	0.00	0.00
75%tile	0.50	0.31	0.14
90%tile	0.54	0.71	0.36

only.

It may sound surprising that large firms issue debt and payout equity at the same time. Table 5 shows that on average 20% of the firms issue debt and payout equity at the same time. In particular the large firms for which we find pro-cylical equity payout and counter-cyclical debt repurchases.

Table 6 presents averages per size bin for our financial variables of interests. All but the largest firms finance on average with both equity and debt. In contrast, large firms payout to shareholders with both dividends and share repurchases and finance with debt. These facts suggest that most firms use good times to raise funds from both debt and equity claim holders. Large firms prefer debt financing in booms and equity financing in recessions. Moreover, investment is decreasing in size, leverage is increasing in size. In the appendix, we also report the mean and volatility of sales– and asset growth. Typically smaller firms have faster and more volatile sales growth. The results are less conclusive with regard to assets.

Figure 3 plots debt repurchase and equity payout (red) for the smallest (left panel) and largest (right panel) asset bin firms from the first quarter in 1984 to the last quarter 2014. The NBER recessions are represented by the yellow bars. The smallest firms finances increase equity payout and debt repurchases in recessions with equity than with debt and equity payout and there is no clear substitution pattern over the business cycle. Firms in the large bin repurchase debt counter-cyclically and tend to payout during booms. That is, they seem to substitute between debt and equity instruments as shown by Jermann and Quadrini (2012).

The aggregated time series (see figure 4) of debt repurchases and equity payout is almost identical to the right panel of figure 3. That is, as shown in table 2, the aggregate firm financing patterns are governed by large firms. Focusing on aggregate data only conceals the financing behavior of the majority of firms. The financing behavior of small and large firms differs significantly over the business cycle. For this reason, we use a heterogeneous firm financing model to explain the impact of financial markets on firms' financing decisions.

Table 6: MEANS

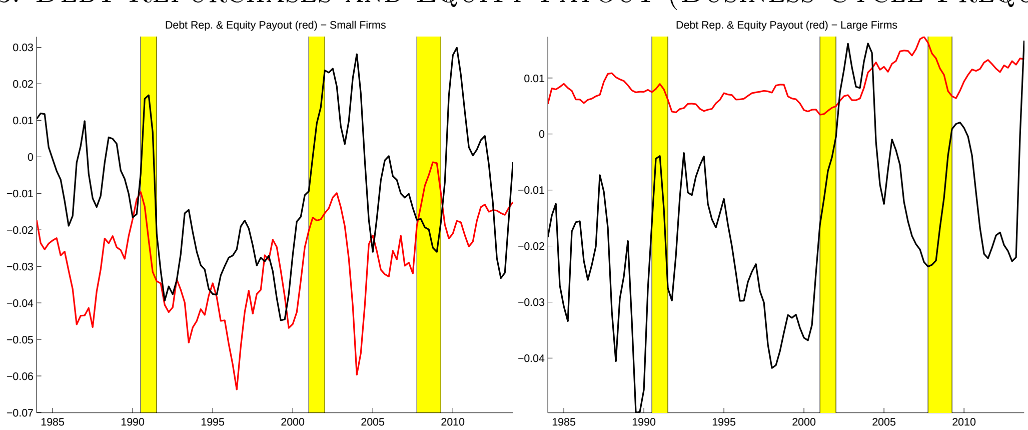
Asset Percentile	Equity Issuance	Equity Dividends	Equity Repurchase	Equity Payout	Debt Repurchase
0-25%	2.44	0.19	0.21	-2.04	-0.2
25-50%	1.57	0.21	0.28	-1.08	-0.73
50-75%	0.85	0.24	0.36	-0.25	-1.57
75-100%	0.26	0.47	0.52	0.74	-1.83

All variables are quarterly and normalized by assets.

Asset Percentile	Assets	Invest.	Leverage
0-25%	231	5.69	0.22
25-50%	$1,027$	5.35	0.23
50-75%	$3,577$	4.63	0.27
75-100%	$51,147$	3.55	0.27

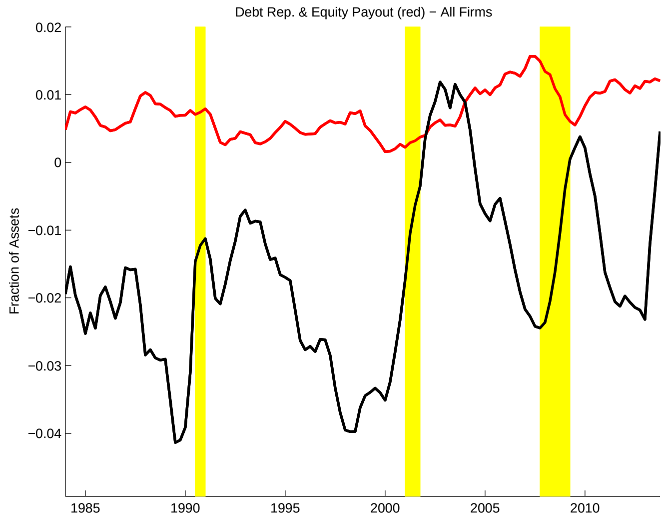
Units of variables marked by are in millions. Investment is the percentage investment rate where investment rate is defined as capital expenditure over lagged assets. Leverage is defined as total debt over lagged assets. All variables are quarterly.

Figure 3: DEBT REPURCHASES AND EQUITY PAYOUT (BUSINESS CYCLE FREQUENCY)



Source: Compustat

Figure 4: Aggregate Debt Repurchases and Equity Payout At Business Cycle Frequency



Source: Compustat

Our model advances a novel mechanism to explain these financing differences and therefore sheds a light on the nature of firms' financial behavior.

3 Quantitative firm dynamics model with financial frictions

In this section we describe the model environment as well as the problem of incumbent and entrant firms. Justification for the various assumptions follows in section 3.3.

3.1 Environment

There is a continuum of heterogeneous incumbent firms that own a decreasing returns to scale technology ($\alpha < 1$). Gross revenue is $F(z, s, k) = zsk^{\alpha}$, where z is the aggregate shock common to all firms, s is the firm specific transitory shock. The common component of productivity z is driven by the stochastic process

$$\log\, z' = \rho_z \log\, z + \sigma_z \epsilon_z',$$

where $\epsilon_z \sim N(0, 1)$. The dynamics of the idiosyncratic component s are described by

$$\log\, s' = \rho_s \log\, s + \sigma_s \epsilon_s',$$

with $\epsilon_s \sim N(0,1)$. Both shocks are independently of each other distributed.

Firms also differ with regard to the capital stock k they own and current debt levels b. The capital stock depreciates at the rate δ each period. The purchase of new capital stock is subject to quadratic adjustment costs:

$$g(k,k') = \frac{c_1}{2}\left(\frac{k'-(1-\delta)k}{k}\right)^2 k. \tag{1}$$

Corporate taxable income is equal to operating profits less economic depreciation and interest expense:

$$T^c(k,b,z,s) \equiv \tau_c\left[zsk^\alpha - \delta k - rb\right],$$

where rb are the default free interest expenses and δk represent the economic depreciation.

External Financing and Financial Frictions

The model features frictions in both equity and debt financing.

A firm can issue a one-period bond at a discount. That is, it can raise funds in the current period $q^b b'$ where $q^b < 1$ and promises to pay back the face value b' next period. Debt is preferred over equity due to a tax-advantage of debt. Investors are risk neutral and therefore use $r = \tilde{r}(1-\tau_i)$ to discount future cash flow streams, where $\tilde{r}$ is the risk-free rate and τ_i is the income tax rate for an investor. However, a firm can also choose to default on its debt obligation. It may default when its firm value falls below a threshold, which we normalized to zero. In this case the firm is liquidated and exits the firm universe.

Upon default shareholders receive the threshold value, e.g. zero. Bondholders receive the recuperation value:

$$RC(k) = \max\left((1-\varepsilon)[(1-\delta)k] - g(k,0) - cf,\ 0\right), \tag{2}$$

where ε represents bankruptcy costs, e.g. any costs related to the liquidation and renegotiation of the firm after default. The recuperation value is lowered by the fixed cost of operation and the adjustment cost the firm incurrs when it moves to zero capital stock.

The firm can also issue equity e to finance itself, where $e < 0$. In this case, firms incur a linear issuance costs:

$$\Lambda(e) \equiv 1_{e<0}\,\lambda e \tag{3}$$

$$\lambda \geq 0$$

where $1_{e<0}$ equals 1 if $e < 0$ and zero otherwise.

Also the firm can payout equity e to the shareholds, where $e > 0$. In this case, the payout is taxed:

$$\Upsilon(e) = 1_{e>0}\tau_e$$

where $1_{e>0}$ equals 1 if $e > 0$ and zero otherwise.

3.2 Firm optimization

This section describes the problem of incumbents and entrants.

Incumbent Firm Problem

Each period the incumbent firm has the option to default on its outstanding debt and exits. The default value is normalized to zero. Therefore, each period the value of the firm is the maximum between the value of repayment and zero, the value of default:

$$V = max\left\{V^{ND}, V^{D} = 0\right\}. \tag{4}$$

The repayment value is

$$V^{ND}\left(z,s,k,b\right) = \max_{k'\in K, b'\in B, e} \begin{cases} \underbrace{e}_{\text{Equity}} + \underbrace{\Lambda(e)}_{\text{Eq.Iss.Cost}} - \Upsilon\underbrace{(e)}_{\text{Eq.Pay.Tax}} \ldots \\ \\ +\frac{1}{1+r}E_{s,z}\left[V\left(z',s',k',b'\right)\right] \end{cases}, \tag{5}$$

where e represents equity payout if $e > 0$ or equity issuance if $e < 0$. The firm maximizes the repayment value by choosing capital k' and debt to be repaid next period b'. Both decisions determine equity which is defined as

$$e = \left(1-\tau_c\right)zsk^{\alpha} - \left(k' - \left(1-\delta\right)k\right) - g(k,k') - c_f + \tau_c\left(\delta k + rb\right) + q^b b' - b. \tag{6}$$

Equity is thus defined as the residual of the after-tax firm revenue less investment and investment adjustment costs $g(k,k')$ less fixed cost of operation c_f plus tax rebates from capital depreciation and interest payments, plus funds raised through debt $q^b b'$ and less debt to repay b.

The time line for the incumbents in the model can be summarized as follows. At the beginning of each period, incumbents carry debt to be repaid and capital for current period production. Upon observing the productivity shocks, the firm receives gross revenues $F(z,s,k)$. A firm then chooses equity payout by choosing capital and debt for the next period b' and k'. At the same time it must pay its operation cost and its previous period debt. Every period the firm faces the decision whether or not to repay its debt. It repays if the value of the business is positive. Otherwise it defaults and exits.

Debt Contract and Debt Pricing

We assume that investors are risk neutral, the price of debt adjusts such that investors break even in expectations. Define $\Delta(k,b)$ as the combination of aggregate and idiosyncratic states such that a firm finds it optimal to default:

$$\Delta(k,b) = \left\{ (s,z) \ s.t. \ V^{ND}(z,s,k,b) \leq 0 \right\}.$$

Risk neutral investors price debt such that they are indifferent between the investment in a riskless asset and the investment in the bond of the firms:

$$(1+r)b' = (1 - Pr_{s,z}(\Delta(k',b'))) \left(1+r^b\right) b' + Pr_{s,z}(\Delta(k',b')) E_{s,z}(RC(k',s',z')).$$

Defining the price of the bond as

$$q^b \equiv \frac{1}{1+r^b},$$

the no-arbitrage condition from risk-neutral debt pricing results in the following expression for the price on the bond

$$q^b(z,s,k',b') = \frac{1 - Pr_{s,z}(\Delta(k',b'))}{1 + r - Pr_{s,z}(\Delta(k',b')) \frac{RC(k')}{b'}}. \tag{7}$$

If the firm is not expected to default the price is $1/(1+r)$. Note that the price of debt is forward looking as opposed to many classical models, see for instance Kiyotaki and Moore (1997).

The probability of default depends on the two stochastic exogenous states, on how much debt the firm has to repay and how much capital it holds. Moreover the higher the recuperation value on each unit of loan, the lower the discount. The more debt to be repayed and the lower the stock of capital, the higher the probability of default and therefore the lower the price of the bond. At the same time, given the persistence of the shocks, the higher the productivity the higher the debt capacity of the firm for a given amount of capital. Note that a change in the price of debt affects the entire loan amount, not only the marginal increase in doubt that caused the price change.

Entrant Problem

The data parallel for entry in the model is the decision of a firm to go public. Every period a constant mass M of potential entrants receives a signal q about their productivity. We specify this signal as Pareto, $q \sim Q(q)$, with parameter ω, allowing for heterogeneous entrants. Firms have to pay an entry fee ($c_e > 0$) that ensures that not all firms find it optimal to enter. This parameter helps us to pin down the size distribution of the entering firms.

Entrants only start operating in the period after the entry decision but must decide today with which capital stock it wants to start production tomorrow. Investment is subject to adjustment costs. Define

$$H = k' - (1-\delta)\, k^{min} + g(k^{min}, k') - q^b b',$$

as investment plus adjustment costs expenditure minus the financing with debt. Investment can be financed with debt and/or equity. H is the share finance with equity. The entrant then incurs the same issuance cost as the incumbent firm. We assume that the expected continuation value depends on the signal, which determines the probability distribution of the next period idiosyncratic shock. The value function of the entrant is

$$V_e(z,q) = \max_{k'} \left\{ -H + I_{H<0} \underbrace{\Lambda(H)}_{Eq.\,Iss.\,cost} + \frac{1}{1+r} E_{q,z}[V(z',s',k',b')] \right\}. \tag{8}$$

Upon entering, entrants have to pay a fixed entry cost c_e. Entrant invests and starts operating if and only if $V_e(z,q) \geq c_e$. Also, the entrant firm can not choose a debt position that has positive probability of default in the next period.

Stationary Firm Distribution Given an initial firms distribution, a recursive competitive equilibrium consists of (i) value functions $V(z,s,k,b)$, $V_e(z,q)$, (ii) policy functions $b'(z,s,k,b)$, $k'(z,s,k,b)$, e, and (iii) bounded sequences of incumbents' measure $\{\Gamma_t\}_{t=1}^{\infty}$ and entrants' measures $\{\varepsilon_t\}_{t=0}^{\infty}$

1. Given r, $V(z,s,k,b)$, and $b'(z,s,k,b)$, $k'(z,s,k,b)$, e solve the incumbents problem
2. $V_e(z,q)$ and $k'(z,q)$ solve the entrants problem
3. For all Borel sets $S \times K \times B \times \Re \times \Re^{+}$ and $\forall t \geq 0$,

$$\varepsilon_{t+1}(S \times K \times B) = M \int_S \int_{Be(K,B,z)} dQ(q) d(H(s'/q))$$

$$Be(K,B,z) = \left\{ p^b \text{ s.t. } k'(z,q) \in K,\ b'(z,q) \in B \text{and } V_e(z,q) \geq c_e \right\}$$

4. For all Borel sets $S \times K \times B \times \Re \times \Re^{+}$and $\forall t \geq 0$,

$$\Gamma_{t+1}(S \times K \times B) = \int_S \int_{B(K,B,z)} d\Gamma_t(k,b,s) dH(s'/s) + \varepsilon_{t+1}(S \times K \times B)$$

$$B(K,B,z) = \{(k,b,s) s.t. V(z,s,b,k) > 0 \text{ and } b \in B \; g(k',k) \in K\}$$

The firm distribution evolves in the following way. A mass of entrants receives a signal and some decide to enter. The signal q defines firms' next period s and their policy function defines their next period capital. Conditional on not exiting, incumbent firms follow the policy function for next period's capital and debt and their next shocks follow the Markov distribution. Each period, the decisions of incumbents and entrants define how many firms inhabit each s, k and b combination.

3.3 Discussion of Assumptions

Technology

The assumption of decreasing returns to scale implies that given the stochastic state, there exists an optimal firm size and it allows us to think about a distribution of firms.

Firms' productivity has an aggregate and an idiosyncratic part. The idiosyncratic shocks give an extra layer of firm heterogeneity, allowing for a better match of the firm size distribution.

Adjustment Costs of Capital

We introduce adjustment costs for capital to generate slow convergence to the optimal firm size implied by the decreasing returns to scale assumption and idiosyncratic productivity. The adjustment costs are also important to break the connection between firm size and idiosyncratic shock. In absence of adjustment costs and financial frictions size would be pinned down by idiosyncratic shock. The adjustment costs allow for a more realistic firm size distribution.

Financial Frictions

Each period a firm maximizes equity payout to their shareholders by making an investment and a capital structure decision. The tax advantage of debt over equity means that the return on equity is larger than the return on debt. From the perspective of the firm, it has to pay a higher risk-adjusted interest rate on equity than on debt. For this reason, debt is preferred over equity. Raising too much debt though is also costly due to firms' default option and a deadweight loss through bankruptcy costs. We follow Arellano et al. (2012) by assuming that bondholders obtain the depreciated assets of the company less the adjustment costs for divesting the assets that is left after paying the bankruptcy cost.

If equity is positive ($e > 0$), it represents a distribution (payout) to the shareholder. Equity payout to shareholders can arise either through repurchase or dividends. Our model does not explicitly distinguish between these two. The payout literature (see Farre-Mensa, Michaely, and Schmalz (2015)) finds that tax consideration contribute little to the way firms choose to payout. Historically, dividend payout is rather smooth whereas payout with repurchases can be quite lumpy. The equity payout variable in the model is the sum of the two and does appear relatively volatile in the data. For this reason, have a flat payout tax τ_e.

If equity is negative ($e < 0$), the firm raises funds using equity. We assume that equity issuance is costly. These costs are motivated with underwriting fees and adverse selection premia. For the model to stay tractable, we do not model costs of external equity as the outcome of an asymmetric information problem. Instead, as in Cooley and Quadrini (2001) we capture adverse selection costs and underwriting fees in a reduced form. The firm incur in linear equity payout costs, λ.

4 Parametrization and Model Fit

This section presents how we parametrize the model and how the model fits the data. We begin by illustrating the effect of three key parameters on the mechanics of the two-period model. We use this intuition to guide our calibration strategy for c_1,c_f, and λ.

The comparative statics of key parameters We now discuss the comparative statics of the key parameters. Figure 5 presents[12] the comparative statics with regard to c_1 (sensitivity of adjustment costs to investment) for the price of debt q, the probability of default, equity payout d, investment i, debt issuance b, and leverage lev. The adjustement cost parameter is critical. The functional form applies that large firm pay less for each unit of investment. A high value of c_1 affects small firms more compared to large firm as can be seen from the figure. It decreases optimal investment. For this reason it lowers debt funding needs and therefore b and consequently leverage.

[12]The parameter values for Figure 5 are as follows:

z	0.5 2.5	λ	0	δ	0.025
π_L	0.8	ξ	0	τ_c	0
π_H	0.05	c_f	0	β	$\frac{1}{1+r}$
α	0.7	c_1	see graph	$\bar{s}$	5

Figure 5: Comparative Statics: Capital Adjustment Cost

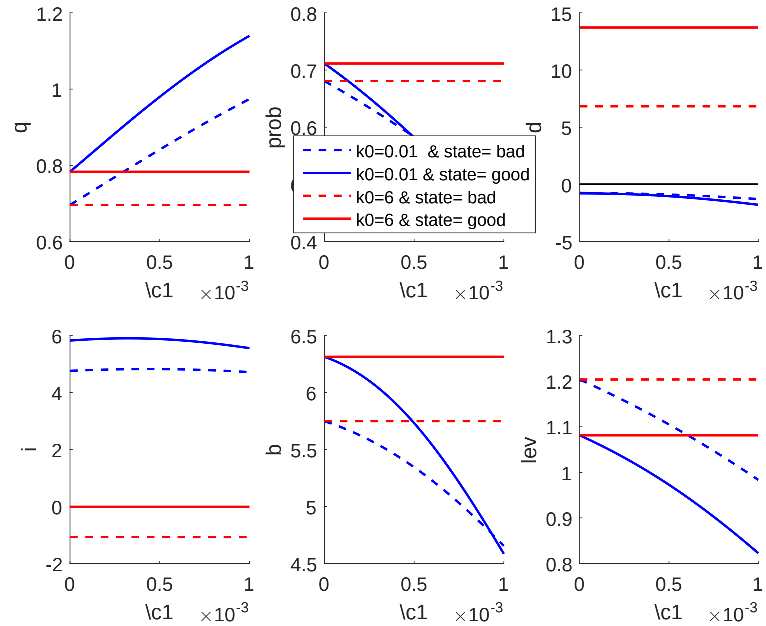


Figure 6 presents[13] the comparative statics with regard to c_f, the fixed cost of operation for the same variables as in Figure 5. The fixed cost of operation , c_f, lowers the recuperation value of the bond, holding everything else fixed. This lowers the bond price, effectively increasing funding costs of investment. *C.p.* a higher capital stock is necessary to keep the recuperation value constant. In order to fund the optimal amount of investment, firms choose less leverage, which increases the bond price and lowers the probability of default.

Finally we study the effect of λ in Figure 7.[14] Similar to c_1 (capital adjustment costs), λ affects small firms only as they are the ones that need equity financing. Since $c_1 > 0$, leverage is lower for small firms. Higher equity issuance costs makes equity financing more costly. Firms need to maximize the proceeds from debt issuance. For this reason, they need to lower leverage by increasing investment and decreasing the face value of the bond. As a result, both c_1 and λ are effective in reducing leverage.

Parametrization The model period is quarterly, so that it is comparable to the data.The choice of parameters can be divided in three different categories. The first category consists

[13] The parameter values for Table 6 are as follows:

z	0.5 2.5	λ	0	δ	0.025
π_L	0.8	ξ	0	τ_c	0
π_H	0.05	c_f	see graph	β	$\frac{1}{1+r}$
α	0.7	c_1	0	$\bar{s}$	5

[14] The parameters for Figure 7 are

z	0.5 2.5	λ	see graph	δ	0.025
π_L	0.8	bk_cost	0	τ_c	0
π_H	0.05	c_f	0	β	$\frac{1}{1+r}$
α	0.7	c_1	0.00065	$\bar{s}$	5

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Figure 6: Comparative Statics: Fix Cost of Operation

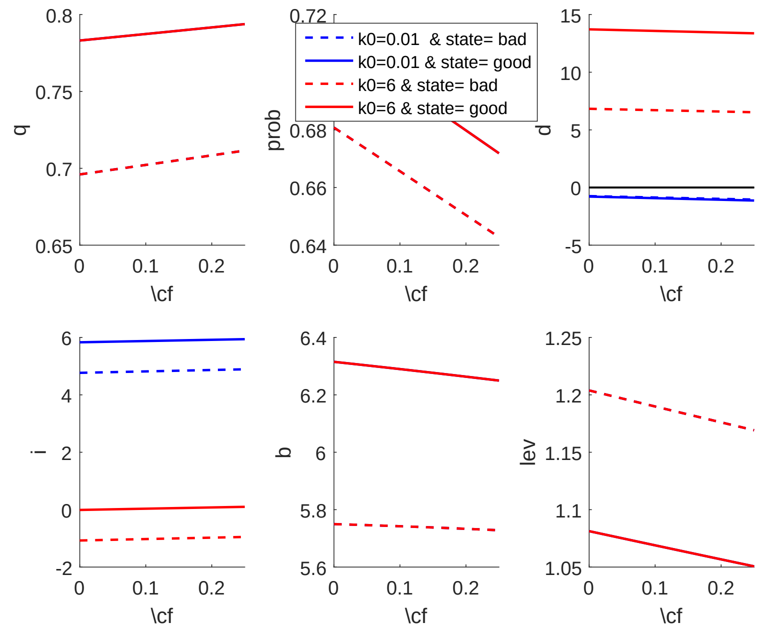


Figure 7: Comparative Statics:

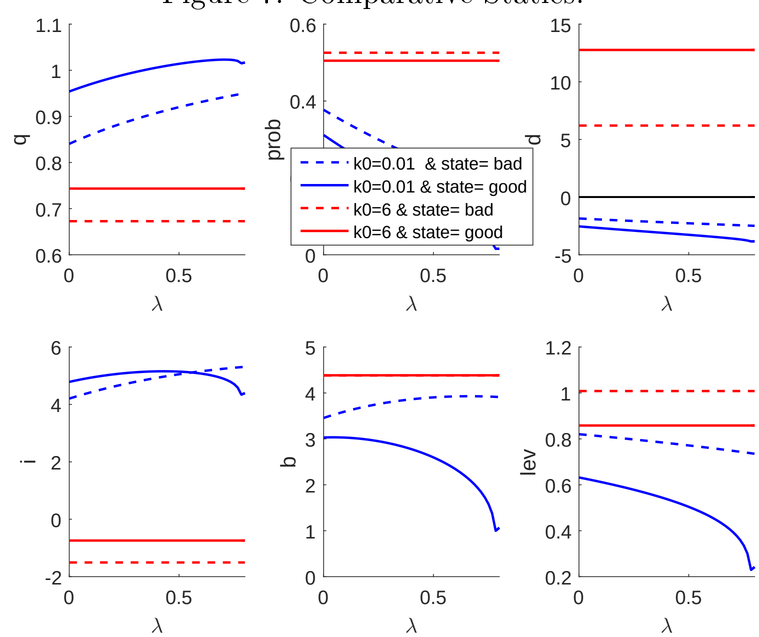


Table 7: PARAMETRIZATION

Parameter	Function	Target
$\alpha = 0.65$	Decreasing returns to scale	Hennessy and Whited (2007)
$\varepsilon = 0.1$	Bankruptcy cost	Hennessy and Whited (2007)
$\tau_i = 0.29$	Individual tax rate	Graham (2000)
$\tau_c = 0.4$	Corporate tax rate	
$\lambda = 0.02$	Equity issuance costs	Gomes and Schmid (2012)
$\delta = 0.025$	Depreciation	NIPA depreciation
$r = 0.01$	riskless rate	4% annualized return
ρ_z=0.8857	Agg. shock persistence	U.S. quarterly GDP
σ_z=0.0093	Agg. shock std	U.S. quarterly GDP vol
$\rho_s = 0.9147$	Idiosy. shock persistence	Imrohoroglu and Tuzel (2014)
$\sigma_s = 0.1486$	Idiosy. shock vol	
$\omega_e = 2$	Pareto: entrant shock	18% entrants rel. size
$c_1 = 0.005$	Inv. adj. cost	Average Investment
$c_f = 54.7$	Fixed cost of operation	Exit equals entry of 1.7%

of parameters that are picked according to the literature such as the decreasing returns to scale parameter. The second group of parameters has a natural data counterpart such as the volatility of the aggregate shock. The last group of parameters is calibrated to jointly target moments in the data. To find these parameters, we first solve the model under a specific set of parameters. Then we simulate data using the policies of the model and compute the target moments. Next, we compare the model implied moments implied by this specific parameter combination. We repeat this procedure until the difference between the data and the model implied target moments has been minimized. Table 7 presents the parametrization. The targets are shown in the last column.

Solution Technique

The model is highly non-linear. Therefore, we need to solve the model globally. Given the parametrization, we find the policies and the value functions of entrants and incumbents using value function iteration.

Model fit

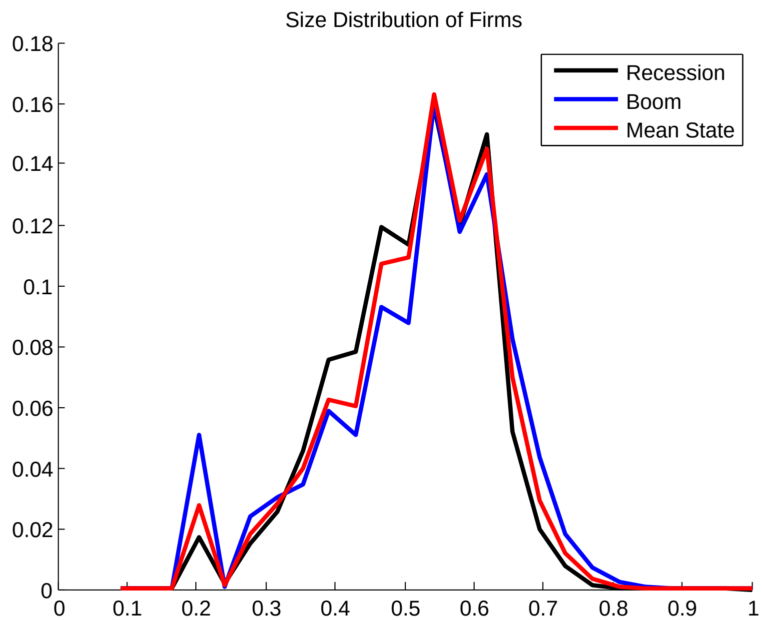
Table 8 shows the data targets of the calibration and the corresponding model counterpart. The non-linearities of the model do not allow us to match all moments exactly.

Endogenous entry and exit affect the firm size distribution over time. Figure 8 plots the average firm size distribution over the normalized assets for different states in the economy. Firms tend to enter small and more firms enter in good economic times during which the

Table 8: Model Fit

Calibrated Moments	Data	Model
Entrants relative size	18.3%	23%
Investment rate	3.9%	3.5%
Exit=entry rate	1.7%	1.5%
Stay bin transition prob.	0.94	0.69

Figure 8: SIZE DISTRIBUTION



distribution gets flatter: the large firms are larger compared to bad states during which the size distribution is more concentrated and shifts to the left.

5 Results

5.1 Mechanism in the quantitative model

This section describes the mechanism of the model that rationalizes the cross-sectional external financing patterns observed in the data. The three important features are firm dynamics, decreasing returns to scale with adjustment costs of investment, and the endogenous default premium on debt.

Given the idiosyncratic and aggregate shock, decreasing returns to scale technologies imply an efficient scale. Moreover, the expected return on investment depends negatively on the size of the firm. With adjustment costs firms can only grow slowly towards their efficient scale. In our setting, shareholders are sufficiently patient to wait for future payouts once the firm has attained its efficient scale. During a boom, as more small firms enter far away from their efficient scale, the funding needs of small firms increase.

Debt is issued at a premium that depends on the likelihood of default and the recuperation value of the bond. The likelihood of default is higher, the lower internal revenues, the higher the loan, and the worse the aggregate and idiosyncratic productivity.

Because of their high funding needs, small firms want to take on as much debt as they can. This pushes them closer to the default region at which the cost of debt spikes up. That is, they are effectively borrowing constrained and must resort to equity financing. Once a firm has attained its efficient scale they payout and finance mostly with debt. Many firms borrow to payout because they issue at the default free rate. This is consistent with the data as documented by Farre-Mensa, Michaely, and Schmalz (2015).

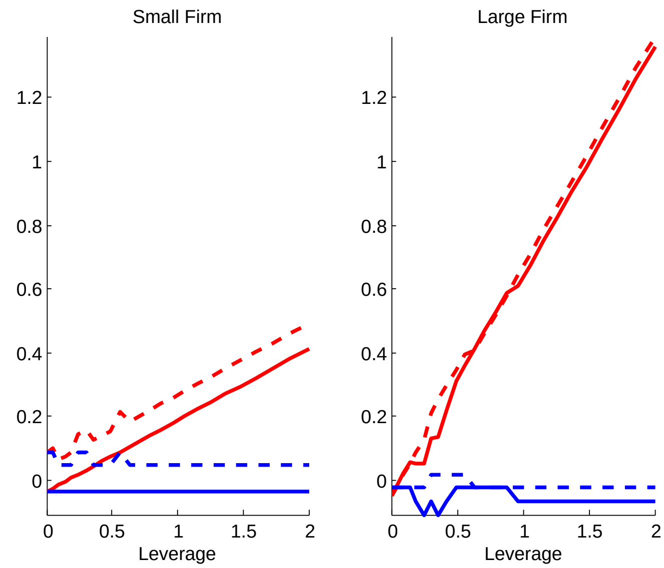
Over the business cycle, the effect described above is amplified. In booms (recession) large firms have higher (lower) internal funds, therefore they will payout more (less). Good aggregates times means better (worse) growth opportunities for small firms and that means higher (lower) financing needs. Therefore small firms issue more (less) in booms (recessions).

We show now how the mechanism plays out in the model. To this end, we examine external needs of funds and investment decisions for small and large firms. Figure 9 plots external needs of funds $\left((1-\tau_c)\, zs\mu k^{\alpha} - (k' - (1-\delta)\, k) + \tau_c \delta k - g(k,k') - c_f - b\left(1-\tau_c(1-\overline{p^b})\right)\right)$ in red and investment policy in blue over current leverage. The solid line shows the funding needs and investment policies in a recession and the dashed line in a boom. Since the idiosyncratic shock has been fixed, these firms are essentially the same, except that the small is farther away and below its efficient scale and the large firm is closer but above its efficient scale. Figure 9 further shows that the more leveraged a firm is the higher are its need of funds.

Figure 9 highlights the first part of our mechanism. Smaller firms have higher needs of funds than large firms in a boom due to their higher return on investment. In this example the large firm must even disinvest to return to its optimal size. This can happen when the firm had a higher idiosyncratic productivity in the previous period. The graph also shows how the business cycle amplifies the mechanism of the model: small firms' needs of funds is much more responsive to the business cycle compared to the large firm. This suggests that most of the action in this model is derived by the entry and financing behavior of small firms.

How do firms decide between their two external funding sources? Suppose a firm intends to increase capital by one unit and must decide how to finance it. If it increases debt it may increase its probability of default in case the firm is close to the default region. Then the

Figure 9: Need for Funds (Red) and Investment Policy (Blue)



This graph depicts the need of funds in red for small firms (left panel) and large firms (right panel) as well as firms' investment policies for both booms (dashed line) and recession (solid line).

price of the entire debt stock decreases. This means that it becomes *more* costly to issue debt. However if it finances with equity the firm incurs issuing cost which decreases the value of the firm.

The Euler equation for capital (equation **??**) shows the benefit from investing an additional unit of capital: the return on production next period and additional internal funds available that could be used to pay off future debt. This is because $\frac{\partial q^b}{\partial k'} > 0$. That is, the higher k' the lower the probability of default and thus the higher the price. Further, the probability of default depends on aggregate conditions. Figure 10 depicts the price of debt as a function of collateral (firm assets) for different aggregate shocks. The better the aggregate condition, the less collateral (capital) is needed for the same price of debt.

The Euler equation for debt determines how the firm chooses its debt financing . If the firm wants to increase the funds received by promising to repay an extra unit tomorrow it raises $\left(q^b + b'\frac{\partial q^b}{\partial b'}\right)$ today. Since $\frac{\partial q^b}{\partial b'} \leq 0$, an upward change in the loan amount may decrease the total amount of funds received from debt today. It will depend on the sensitivity of the price of debt to the amount borrowed. The default premium generates an endogenous debt ceiling that depends on size.

Each panel in figure 11 plots the price of debt for a firm of a given size (from the top panel to the bottom panel we depict small to large firms) with the same idiosyncratic

Figure 10: Price of Debt

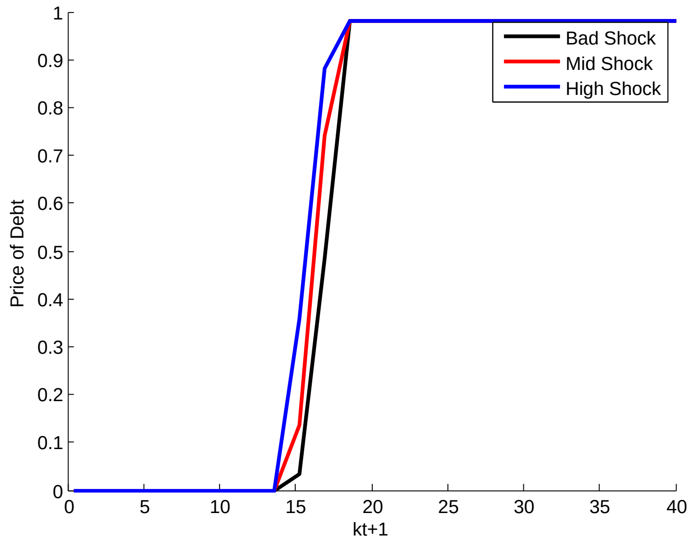


Figure 11: Price of Debt

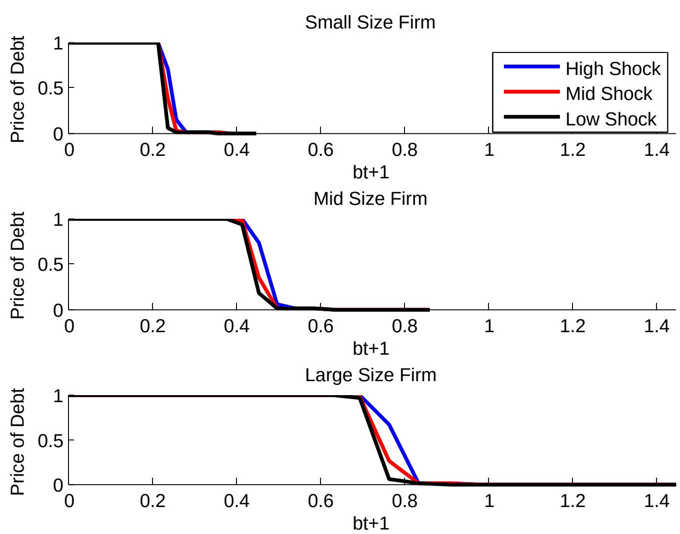
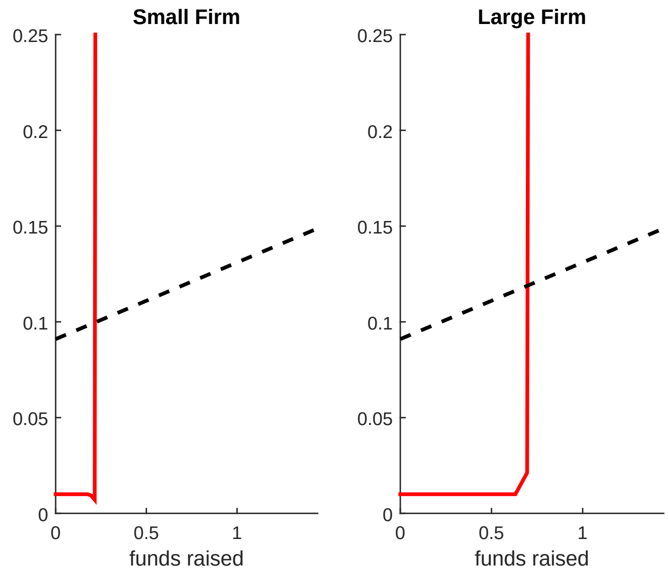


Figure 12: Marginal Costs of Debt and Equity Financing



productivity. These firms have the same optimal size. The price of debt is plotted as a function of the promised repayment amount during a boom, recession, and normal times. The amount of funds firms receive for their promise today is the price times the promise. The small firm in the top panel is affected by the endogenous debt ceiling. That is, even if this firm were to promise to repay a lot, a lender anticipates a default with certainty and thus effectively refuses to provide any funds by charging a price of 0. In contrast, the debt ceiling of a large firm is higher and therefore gives the firm cheaper access to debt financing for larger amounts of debt funds.

Firms with high funding needs but relatively low debt ceilings may find it cheaper to finance with equity. Figure 12 plots the marginal costs of equity and debt financing for small (left panel) and large firms (right panel). Since small firms have relatively high funding needs and hit the endogenous debt ceiling faster, equity becomes relatively more attractive. As the marginal cost of debt slopes up after the debt ceiling is reached, the marginal cost of equity becomes lower than the marginal cost of debt. Large firms only finance with equity if they need a lot of funds which is rarely the case. In booms small firms have even higher needs of funds, hence they will issue even more equity.

Table 9: Business Cycle Correlation of Financial Variables

	Correlation with quarterly GDP			
	Data		Model	
Bin	Equity Pay	Debt Rep	Equity Pay	Debt Rep
0-25%	**−0.21**	**−0.53**	−0.73	−0.72
25-50%	**−0.24**	**−0.72**	−0.30	−0.62
50-75%	−0.03	**−0.63**	0.56	−0.53
75-100%	**0.75**	**−0.76**	0.75	−0.38

5.2 Cross-sectional differences in business cycle correlation of external financing variables

The optimization generates policies for every firm. We simulate these firms for a large number of periods, allowing for entry and exit according to the firm distribution discussed in section 3.2. We discard the first half of the simulated periods and treat the data the same way as we treat the Compustat data. That is, we sort firms into bins based on their capital, calculate debt repurchase and equity payout for each firm, and form cross-sectional bin sums. Then we band-pass the bin aggregated variable and scale it by the bin sum of assets. Finally, we obtain the correlations with the aggregate shock (also band-passed). We repeat the simulation and moments calculation multiple times and form averages of the moments. Table 9 compares the data against the non-targeted simulated moments of the model. It shows that our mechanism can generate similar cyclical financing patterns as the data without exogenous time-varying adjustment costs. Equity payout is counter-cyclical for the first three bins and pro-cyclical for the last bin (large firms). Debt repurchase is counter-cyclical across all bins as in the data.

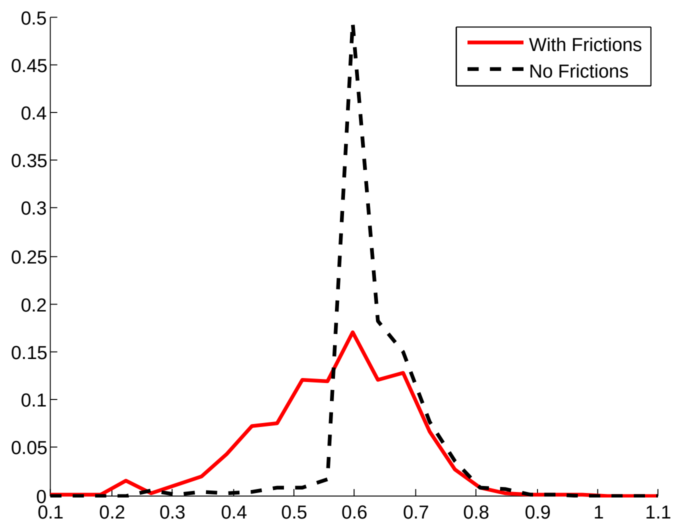
Our mechanism rationalizes these cyclical patterns in the following way: small firms need more funds in booms and cannot satisfy their funding needs with debt alone. This motivates them to issue equity, generating counter-cyclical equity payout. In recessions, the growth opportunities decrease and so do the needs of funds. Consequently firms issue less. In good aggregate times, large firms have more internal funds and are able to use those to increase pay out. Large firms always finance with debt and finance more (repurchase less) in booms.

Table 10 shows other cross-sectional moments that have not been targeted by the calibration such as the average investment rate per bin and leverage.

Table 10: Cross-sectional moments

	Means			
	Data		Model	
Bin	Investment	Leverage	Investment	Leverage
0-25%	5.69	0.21	8.96	0.84
25-50%	5.35	0.23	3.73	0.88
50-75%	4.63	0.27	2.31	0.90
75-100%	3.55	0.27	-0.0096	0.92

Figure 13: Firm Size Distribution



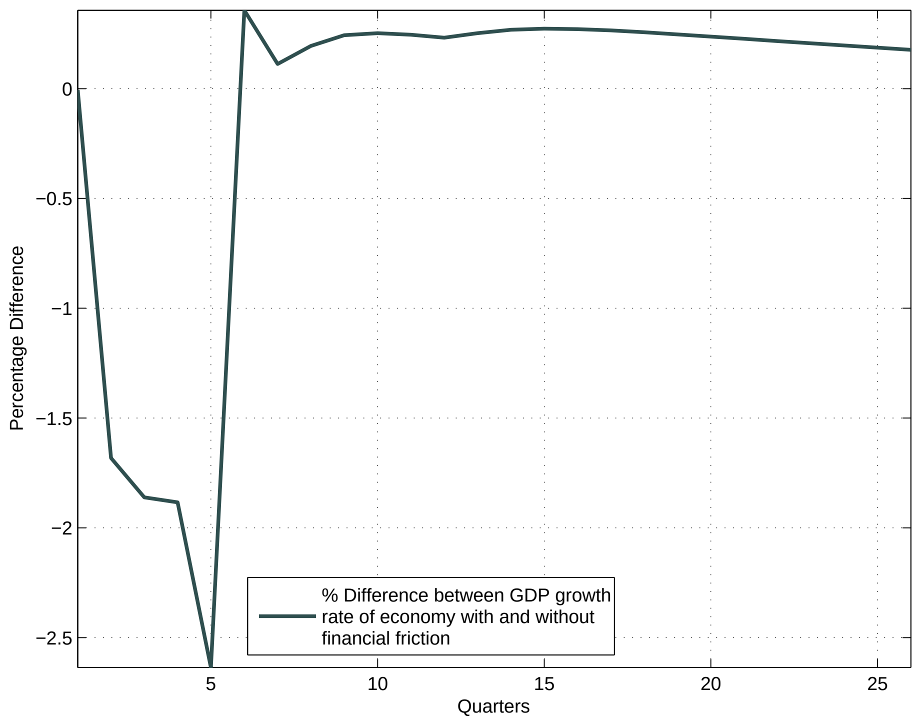
5.3 Amplification

Firm dynamics and financial frictions matter for the macro-economy only in so far they lead to amplifications and propagation of shocks. In order to get a sense for the model's amplification potential we compare the full benchmark model with an economy that has no financial frictions aside of a tax-advantage of debt. That is, there are no bankruptcy or equity issuance costs in this model.

We obtain the stationary distribution of the model with financial frictions and without financial frictions. This is shown in figure 13. The size distribution of the economy with financial frictions is skewed to the left and has a fat tail on the right which is similar to the data. The size distribution of the economy without financial frictions is highly concentrated around the optimal scale of firms and lacks skewness to the left. In our model economy, financial frictions in the form of external financing costs prevent firms from attaining their efficient scale quickly.

How do these two different economies react differently to a bad aggregate shock? In

Figure 14: Amplification



order to answer this questions, we start from the stationary distribution of each economy. We simulate each economy for four quarters with a shock that is one standard deviation lower than the mid-sized aggregate shock. After that the aggregate shock returns back to its mid-size level. Last, we compute aggregate output growth for each economy. Figure 14 presents the percentage difference of output growth in the financial friction economy and the economy without financial frictions. It shows that the recession has a stronger impact on the economy with financial frictions. This is because financial frictions make it harder to buffer economic shocks and are forced to exit. A bad aggregate shock discourages firms to enter in particular when external funds are expensive, leading to a worse recession in that case.

6 Conclusion

We show that aggregate shocks and endogenous firm dynamics in conjunction with external equity financing costs and defaultable debt pricing affect how the cross-section of firms finances investment over the business cycle. In the data, large firms make more extensive use of equity instead of debt financing during economic downturns. In good times, they pay out to their shareholders. In contrast, smaller firms appear not to substitute external financing sources over the business cycle. They use more debt and equity financing during booms.

The model proposes an explanation for the cyclical movements and the cross-sectional differences of firm financing. Smaller firms have higher funding needs because they are farther away from their efficient scale. At the same time, debt financing is relatively more costly to them since they can pledge less collateral. Booms represent good investment opportunities and therefore higher funding needs. These higher investment needs cannot be financed with debt alone, small firms turn to equity financing. Large firms are closer to their efficient scale and have lower funding needs relative to the collateral that can be pledged to bond holders. This allows them to borrow cheaply, in particular during booms. Large firms' borrowing costs are so low that they can borrow to finance payouts to shareholders.

Endogenous firm dynamics and financial frictions amplify aggregate shock and increase firm heterogeneity. Our analysis underscores that the interplay between firm dynamics and financial frictions are important to understand firms' financial positions and investment behavior over the business cycle.

References

Acharya, V. V., H. Almeida, and M. Campello (2007). Is cash negative debt? a hedging perspective on corporate financial policies. *Journal of Financial Intermediation 16*(4), 515–554.

Altinkilic, O. and R. S. Hansen (2000). Are there economies of scale in underwriting fees? evidence of rising external financing costs. *Review of Financial Studies 13*(1), 191–218.

Arellano, C., Y. Bai, and J. Zhang (2012). Firm dynamics and financial development. *Journal of Monetary Economics 59*(6), 533 – 549.

Baxter, M. and R. G. King (1995, February). Measuring business cycles approximate band-pass filters for economic time series. NBER Working Papers 5022, National Bureau of Economic Research, Inc.

Belo, F., X. Lin, and F. Yang (2014). External equity financing shocks, financial flows, and asset prices. *Charles A. Dice Center Working Paper* (2014-08).

Bergin, P., L. Feng, and C.-Y. Lin (2014, May). Financial frictions and firm dynamics. Working Paper 20099, National Bureau of Economic Research.

Bernanke, B. S. and M. Gertler (1989, February). Agency Costs, Net Worth, and Business Fluctuations. *The American Economic Review 79*, 14–31.

Bernanke, B. S., M. Gertler, and S. Gilchrist (1999, April). The financial accelerator in a quantitative business cycle framework. In J. B. Taylor and M. Woodford (Eds.), *Handbook of Macroeconomics*, Volume 1 of *Handbook of Macroeconomics*, Chapter 21, pp. 1341–1393. Elsevier.

Bhamra, H. S., L.-A. Kuehn, and I. A. Strebulaev (2010a). The aggregate dynamics of capital structure and macroeconomic risk. *Review of Financial Studies 23*(12), 4187–4241.

Bhamra, H. S., L.-A. Kuehn, and I. A. Strebulaev (2010b). The levered equity risk premium and credit spreads: A unified framework. *Review of Financial Studies 23*(2), 645–703.

Bolton, P., N. Wang, and J. Yang (2014). Investment under uncertainty and the value of real and financial flexibility.

Bustamante, M. C. (2011). How do frictions affect corporate investment?: a structural approach.

Carlstrom, C. T. and T. S. Fuerst (1997, December). Agency costs, net worth, and business fluctuations: A computable general equilibrium analysis. *American Economic Review 87*(5), 893–910.

Chen, H. (2010). Macroeconomic conditions and the puzzles of credit spreads and capital structure. *The Journal of Finance 65*(6), 2171–2212.

Clementi, G. L., A. Khan, B. Palazzo, and J. K. Thomas (2014a). Entry, exit and the shape of aggregate fluctuations in a general equilibrium model with capital heterogeneity. Technical report.

Clementi, G. L., A. Khan, B. Palazzo, and J. K. Thomas (2014b). Entry, exit and the shape of aggregate fluctuations in a general equilibrium model with capital heterogeneity. *Unpublished Working Paper*.

Clementi, G. L. and B. Palazzo (2013, July). Entry, exit, firm dynamics, and aggregate fluctuations. Working Paper 19217, National Bureau of Economic Research.

Cooley, T., R. Marimon, and V. Quadrini (2004). Aggregate consequences of limited contract enforceability. *Journal of Political Economy 112*(4), pp. 817–847.

Cooley, T. F. and V. Quadrini (2001, December). Financial markets and firm dynamics. *American Economic Review 91*(5), 1286–1310.

Cooper, R. W. and J. C. Haltiwanger (2006). On the nature of capital adjustment costs. *Review of Economic Studies 73*(3), 611–633.

Covas, F. and W. J. Den Haan (2011, April). The cyclical behavior of debt and equity finance. *The American Economic Review 101*, 877–899(23).

Covas, F. and W. J. Den Haan (2012). The role of debt and equity finance over the business cycle. *The Economic Journal 122*(565), 1262–1286.

Dittmar, A. K. and R. F. Dittmar (2008). The timing of financing decisions: An examination of the correlation in financing waves. *Journal of Financial Economics 90*(1), 59–83.

Dunne, T., M. J. Roberts, and L. Samuelson (1988). Patterns of firm entry and exit in us manufacturing industries. *The RAND Journal of Economics*, 495–515.

Eisfeldt, A. and T. Muir (2015). Aggregate external financing and savings wave.

Eisfeldt, A. L. and A. A. Rampini (2006). Capital reallocation and liquidity. *Journal of Monetary Economics 53*(3), 369 – 399.

Fama, E. F. and K. R. French (2002). Testing trade-off and pecking order predictions about dividends and debt. *Review of Financial Studies 15*(1), 1–33.

Farre-Mensa, J., R. Michaely, and M. C. Schmalz (2015). Financing payouts.

Fazzari, S. M., R. G. Hubbard, and B. C. Petersen (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity 19*(1988-1), 141–206.

Field, L. C. and J. M. Karpoff (2002). Takeover defenses of ipo firms. *The Journal of Finance 57*(5), 1857–1889.

Frank, M. Z. and V. K. Goyal (2003, February). Testing the pecking order theory of capital structure. *Journal of Financial Economics 67*(2), 217–248.

Frank, M. Z. and V. K. Goyal (2009). Capital structure decisions: Which factors are reliably important? *Financial Management 38*(1), pp. 1–37.

Gomes, J. F. (2001). Financing investment. *The American Economic Review 91*(5), pp. 1263–1285.

Gomes, J. F. and L. Schmid (2012). Equilibrium credit spreads and the macroeconomy.

Gourio, F. and M. Michaux (2012, March). Financing investment with long-term debt and uncertainty shocks. Working paper.

Graham, J. R. (2000). How big are the tax benefits of debt? *The Journal of Finance 55*(5), 1901–1941.

Hackbarth, D., J. Miao, and E. Morellec (2006). Capital structure, credit risk, and macroeconomic conditions. *Journal of Financial Economics 82*(3), 519 – 550.

Hadlock, C. J. and J. R. Pierce (2010). New evidence on measuring financial constraints: Moving beyond the kz index. *Review of Financial studies 23*(5), 1909–1940.

Hennessy, C. A. and T. M. Whited (2005, 06). Debt dynamics. *Journal of Finance 60*(3), 1129–1165.

Hennessy, C. A. and T. M. Whited (2007). How costly is external financing? evidence from a structural estimation. *The Journal of Finance LXII*(4).

Hopenhayn, H. A. (1992). Entry, exit, and firm dynamics in long run equilibrium. *Econometrica: Journal of the Econometric Society*, 1127–1150.

Jacobson, T., J. Linde, and K. Roszbach (2013). Firm default and aggregate fluctuations. *Journal of the European Economic Association 11*(4), 945–972.

Jermann, U. and V. Quadrini (2006, June). Financial innovations and macroeconomic volatility. Working Paper 12308, National Bureau of Economic Research.

Jermann, U. and V. Quadrini (2012). Macroeconomic effects of financial shocks. *American Economic Review 102*(1), 238–71.

Kahle, K. M. and R. M. Stulz (2010, August). Financial policies and the financial crisis: How important was the systemic credit contraction for industrial corporations? Working Paper 16310, National Bureau of Economic Research.

Khan, A., T. Senga, and J. K. Thomas (2014). Credit shocks in an economy with heterogeneous firms and default. *Ohio State University mimeo*.

Khan, A. and J. K. Thomas (2013). Credit shocks and aggregate fluctuations in an economy with production heterogeneity. *Journal of Political Economy 121*(6), 1055–1107.

Kiyotaki, N. and J. Moore (1997, April). Credit cycles. *Journal of Political Economy 105*(2), 211–48.

Kocherlakota, N. (2000). Creating business cycles through credit constraints. *Federal Reserve Bank of Minneapolis Quarterly Review 24*(3), 2–10.

Korajczyk, R. A. and A. Levy (2003). Capital structure choice: macroeconomic conditions and financial constraints. *Journal of Financial Economics 68*(1), 75 – 109.

Krishnamurthy, A. (2003). Collateral constraints and the amplification mechanism. *Journal of Economic Theory 111*(2), 277 – 292.

Kurlat, P. (2013). Lemons markets and the transmission of aggregate shocks. *The American Economic Review 103*(4), 1463–1489.

Levy, A. and C. Hennessy (2007). Why does capital structure choice vary with macroeconomic conditions? *Journal of Monetary Economics 54*(6), 1545 – 1564.

Loughran, T. and J. Ritter (2004). Why has ipo underpricing changed over time? *Financial Management*, 5–37.

McKeon, S. B. (2013). Firm-initiated versus investor-initiated equity issues. Technical report, University of Oregon.

Miao, J. (2005). Optimal capital structure and industry dynamics. *The Journal of Finance 60*(6), pp. 2621–2659.

Muir, T. and A. L. Eisfeldt (2014). Aggregate issuance and savings waves. *Available at SSRN 1984063*.

Strebulaev, I. A. (2007). Do tests of capital structure theory mean what they say? *The Journal of Finance 62*(4), 1747–1787.

Strebulaev, I. A. and T. M. Whited (2012). Dynamic models and structural estimation in corporate finance. *Foundations and Trends in Finance 6*, 1–163.

Syverson, C. (2011). What determines productivity? *Journal of Economic Literature 49*(2), 326–65.

A Two-period model FOC

the problem of an individual firm with initial capital stock $k_{0,i}$ is to maximize the discounted sum of equity payout:

$$V\left(k_{0,i}\right)=\max_{k_{i,1},b_i,\text{default}} \quad d_{0,i}+\Lambda\left(d_{0,i}\right)+\beta E_0 \max\left(0,d_{1,i}\right).$$

Given an initial capital stock k_0, all firms are ex-ante identical. Furthermore, given the independence of the idiosyncratic shock s and using the law of large numbers, we can rewrite the value function as

$$V\left(k_0\right)=\max_{k_1,b} \; d_0+\Lambda\left(d_0\right)+\beta\frac{\text{Prob}\left(s\leq s^*\right)}{2}\left[\left(1-\tau_c\right)zk_1^{\alpha}+\left(1-\delta\left(1-\tau_c\right)\right)k_1-\left(1-\tau_C r\right)b-c_f\right],$$

where $\text{Prob}\left(s\leq s^*\right)$ is the probability of survival

$$\text{Prob}\left(s\leq s^*\right)=\frac{s^*}{\bar{s}}=\frac{\left(1-\tau_c\right)z_1k_1^{\alpha}+\left(1-\delta\left(1-\tau_c\right)\right)k_1-\left(1-\tau_C r\right)b-c_f}{\bar{s}}$$

and s^* is the threshold value. That is, for all $s_i>s_i^*$ the firm defaults and continues otherwise. The price of the debt in period 0 is set such that an risk-neutral investor is indifferent between investing in a risk free and the risky bond:

$$1+r=\left(1+r^b\right)\text{Prob}\left(s\leq s^*\right)+\left(1-\xi\right)\left(1-\text{Prob}\left(s\leq s^*\right)\right)\frac{\left(\left(1-\delta\right)k-c_f\right)}{b},$$

where ξ is the bankruptcy cost. That is with $\xi=1$, all is lost in case of default. Otherwise debtholders can recuperate the residual value. Defining $q\equiv\frac{1}{1+r^b}$, we can solve for the bond price as:

$$q\left(k,b\right)=\frac{\text{Prob}\left(s\leq s^*\right)}{1+r-\left(1-\text{Prob}\left(s\leq s^*\right)\right)\left(1-\xi\right)\frac{\left(\left(1-\delta\right)k-c_f\right)}{b}}.$$

We can solve this model analytically for a given initial capital stock level, k_0, and for an initial aggregate state z_0.

The first order conditions with respect to k_1 are

$$\begin{aligned}\frac{\partial V\left(k_0\right)}{\partial k_1} &= \left(-1-c_1\left(\frac{k_1-(1-\delta)k_0}{k_0}\right)+\frac{\partial q\left(k_1,b\right)}{\partial k_1}b\right)\left(1+\Lambda\left(d_0\right)\right)+\beta\left(\frac{\partial\text{Prob}\left(s\leq s^*\right)}{\partial k_1}d_1\right)\\ &= 0\end{aligned}$$

where

$$\frac{\partial \text{Prob}\left(s \leq s^*\right)}{\partial k_1} = \frac{\alpha\left(1-\tau_c\right) z_1 k_1^{\alpha-1} + \left(1-\delta\left(1-\tau_c\right)\right)}{\bar{s}}$$

and $\frac{\partial q(k_1,b)}{\partial k_1} > 0$. The first order conditions with respect to b is

$$\begin{aligned}\frac{\partial V\left(k_0\right)}{\partial b} &= \left(q\left(k_1,b\right) + \frac{\partial q\left(k_1,b\right)}{\partial b_1} b\right)\left(1+\Lambda\left(d_0\right)\right) + \beta \frac{\partial \text{Prob}\left(s \leq s^*\right)}{\partial b} d_1, \\ &= 0\end{aligned}$$

where

$$\frac{\partial \text{Prob}\left(s \leq s^*\right)}{\partial b} = -\frac{\left(1-\tau_C r\right)}{\bar{s}}$$

and $\frac{\partial q(k_1,b)}{\partial b_1} < 0$.

B Data

We download the Compustat/CRSP merged data file from the first quarter in 1978 until the last quarter in 2014 from WRDS. We keep firms that are incorporated in the United States and drop financial (SIC codes 6000-6999), utility (SIC codes 4900-4949), and quasi-government (SIC codes 9000-9999) firms. We drop observations with missing or negative values of assets (atq), sales (saleq), and cash and short term investment securities (cheq). We also discart observations with missing liabilities (ltq) and observations where cash holdings are larger than assets. Firms must have at least 5 observations (5 quarters) to be included into our sample. We convert year-to-date into quarterly values of the sale and purchase of common and preferred stock, cash dividends, and capital expenditures on the company's property, plant and equipment. We delete observations for which the year-to-date into quarterly observations results in negative values. Moreover, we drop GE, Ford, Chrysler and GM from the sample because those firms were most affected by the accounting change in 1988.

Following the business cycle literature, we compute correlations for the time period starting with the first quarter of 1984 until the last quarter of 2014. In the main text, we show our empirical results excluding the first quarter from each firm's time series to focus on non-IPO effects. In the appendix we present results for the case when the first quarter is included in the sample, and results for the case when the entire first year is excluded from the sample.

Following Dunne et al. (1988) we define entrants' relative size as the average size of entering firms relative to incumbents (in the sense of being a public firm).

Table 11: Panel Characteristics

	Overall		Between		Within
Asset Percentile	Freq.	%	Freq.	%	%
0-25%	132340	25	6988	51	65
25-50%	132305	25	7689	57	49
50-75%	132329	25	6166	45	50
75-100%	132322	25	3429	25	64
Total	529296	100	24272	179	56

Table 11 presents the panel characteristics before we aggregate the data up to asset percentiles. It shows in column "between" that smaller firms are more numerous. To put it differently, there are far fewer firms that ever have been classified as a firm in the largest asset percentile than in the smaller asset percentiles. The table furthermore shows that firms move quite a bit across firm size over their observed life span as shown in the "within" column. This column shows that conditional on ever being a firm in the smallest bin, this firm spends 65% of its observed life span in the first bin, implying that it is categorized as a different bin size in the other 35% of its observations.

C Sorting firms into age versus size based portfolios

In the main text (see section 2.2), we showed how the financing patterns of firms differs across different sizes. The mechanism, spelled out in the model, relies on the assumption that small firms want to grow more than large firms. Intuitively, the same mechanism should be in place for young firms versus old firms.

To test this idea, we match firms in Compustat to the data set of the Field-Ritter dataset[15] of company founding dates. Table 12 presents the business cycle correlations of the financial variables when firms are binned according to their age . Through the matching procedure we loose around 60% of the data from the original sample. The correlation coefficient are nevertheless qualitatively similar (see table 2 in the main text). Younger firms do not substitute between equity and debt financing over the business cycle whereas older firms do. We prefer the asset based binning process since this maximizes the number of observations and asset size and age tend to be negatively correlated in the data.

Using the same sample that has been matched to the Field-Ritter dataset, we show the qualitative equivalence between computing correlations for different age bins (see table 12) versus differente size bins (see table (13).

[15] http://bear.warrington.ufl.edu/ritter/FoundingDates.htm

Table 12: Age Sample: Business Cycle Correlation of Equity Payout and Debt Repurchases

Age Percentile	Equity Payout	Debt Repurchases
0-25%	**−0.35**	**−0.22**
25-50%	0.10	**−0.57**
50-75%	**0.41**	**−0.53**
75-100%	**0.63**	**−0.40**
Aggregate	**0.31**	**−0.61**

We compute the correlations of quarterly real GDP with the deflated band-passed filtered components of equity payout and debt repurchases, scaled by the trend of assets. The numbers in bold are significant at the 5% level. Sample is smaller as not all firms could be matched to the Jay Ritter data set that has the age of firms.

Table 13: Age Sample: Business Cycle Correlation of Equity Payout and Debt Repurchases

Asset Percentile	Equity Payout	Debt Repurchases
0-25%	−0.15	**−0.50**
25-50%	**−0.31**	**−0.59**
50-75%	−0.18	**−0.62**
75-100%	0.44	**−0.59**
Aggregate	**0.31**	**−0.61**

Firms in this sample could be matched to the Field-Ritter dataset.
We compute the correlations of quarterly real GDP with the deflated band-passed filtered components of equity payout and debt repurchases, scaled by the trend of assets. The numbers in bold are significant at the 5% level.

Table 14: Business Cycle Correlation of other financial variables

Asset Percentile	ΔCash	Equity Issu.	Equity Rep
0-25%	0.15	**0.36**	**0.72**
25-50%	0.07	**0.39**	**0.65**
50-75%	-0.13	**0.38**	**0.68**
75-100%	$\mathbf{-0.39}$	**0.49**	**0.76**
Aggregate	$\mathbf{-0.35}$	**0.48**	**0.76**

We compute the correlations of quarterly real log GDP with the deflated band-passed filtered components of of changes in cash and marketable securities, book leverage (debt/assets) and equity issuance. All variables are scaled by the trend of assets. The numbers in bold are significant at the 5% level.

Table 15: Business Cycle Correlation of Equity Payout and Debt Repurchases: 1975q1 -2014q4

Age Percentile	Equity Payout	Debt Repurchases
0-25%	$\mathbf{-0.17}$	$\mathbf{-0.41}$
25-50%	-0.13	$\mathbf{-0.57}$
50-75%	-0.02	$\mathbf{-0.33}$
75-100%	**0.50**	-0.01
Aggregate	**0.47**	-0.07

We compute the correlations of quarterly real GDP with the deflated band-passed filtered components of equity payout and debt repurchases, scaled by the trend of assets. The numbers in bold are significant at the 5% level. Sample is from 1975q1 until 2014 q4.

D Business cycle correlations of other financial variables

In this section we present the empirical results after excluding the first year and the first three years of new firms respectively. The surviving firms are larger and therefore behave more as the largest bin in the full sample. The more firms we exclude from the sample the stronger becomes the positive correlation of equity payout with the business cycle.

E Mean and Volatility of Sales Growth

Table 16 presents the mean and standard deviation of sales and asset growth. Small firms outpace large firms in terms of sales growth rates. Sales growth is also more variable for smaller firms. Asset growth rates tend to be larger for larger firms. This relationship is

Table 16: . MEAN YEAR-ON-YEAR CHANGE

	Mean in %		Std	
Asset Percentile	Sales	Asset	Sales	Asset
0-25%	77	8	4	0.3
25-50%	52	17	3	0.6
50-75%	27	20	1	0.6
75-100%	17	19	0.9	0.3

Mean and standard deviation of year on year growth rates for sales and assets, per firm, averaged across bins and time.

however not monotonic.

F Leverage by size and tobin's q

Leverage

Percentiles	Assets				
Tobin's Q	0-25%	25-50%	50-75%	75-100%	Agg.
0-25%	0.18	0.22	0.26	0.27	0.27
25-50%	0.25	0.28	0.32	0.29	0.30
50-75%	0.25	0.26	0.28	0.27	0.28
75-100%	0.20	0.19	0.21	0.23	0.22
Agg.	0.22	0.24	0.27	0.27	0.27

Short term and long term debt relative to assets; Columns: firms sorted according to industry specific assets. Rows: percentiles in terms of industry specific Tobin's Q.