Firm Financing over the Business Cycle

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Abstract

This paper studies how firms choose external financing over the business cycle. First, we document the external firm financing behavior over the business cycle using Compustat data. We find that firm financing is cyclical, but that the cyclicality depends on size. Whereas large firms substitute between debt and equity financing over the business cycle, small firms increase the amount of funds raised, using both debt and equity financing, in good times and reduce it in bad. Second, we propose a mechanism that explains this empirical feature in a heterogeneous firm optimization model with endogenous firm dynamics. Our mechanism is based on three main features: endogenous firm dynamics, decreasing returns to scale, and endogenous defaultable debt pricing. Potential entrants enter small and more so during booms. Small firms are growing and therefore have higher funding needs compared to large firms. The cost of debt financing depends endogenously on the default probability of the firm as well as on the recuperation value of the bond. These features generate that small firms' funding needs cannot be quenched by debt alone. Especially not in booms when growth opportunities and therefore funding needs are high. Thus, they turn to equity. Large firms pay out to their shareholders with the cheapest source of funding available. In recessions, debt becomes relatively more expensive through rising default probabilities, so large firms turn to equity financing.

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1 Introduction

The recent financial crisis has drawn attention to the macroeconomic effects of changes in financial market conditions. One important link between financial markets and the real economy is established by firms seeking external funds from financial markets. Studying this link sheds light on how financial markets influence the real economy and how relevant financial frictions are.

We approach this topic by looking at the empirical relationship of firm financing and the business cycle. In particular, we present empirical results that show large differences in the external financing behavior between firms of different sizes, on average and over the business cycle. Then, we study the effects of financial and productivity shocks on investment and financing decisions of heterogeneous firms in a firm optimization model with financial frictions.

In the empirical part of the paper we use quarterly firm level data from Compustat to analyze the firm financing behavior over the business cycle. To this end, we sort firms based on their sector specific asset position in four firm size portfolios. 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.

Looking at the business cycle moments, we find that the largest firm size portfolio exhibits counter-cyclical debt repurchase and pro-cyclical equity payout. That is, large firms finance with debt in booms and with equity in recessions. We observe a strong negative correlation between these two series, indicating substitution between means of external financing over the business cycle. This fact has been established on a macro level by Jermann and Quadrini (2012) who used aggregate Flow of Funds data to establish this result. We also look at cross-sectional differences in default probabilities over the business cycle.

In contrast, when we repeat the correlation exercise with the small firm size portfolio, we find that small firms lack this kind of substitutability between external financing methods. In particular instead of paying their equity holders, small firms issue equity in order to finance themselves along with debt. In booms small firms increase external financing whereas in recessions external financing is reduced. Moreover on average, small firms acquire more funds through equity than through debt which we interpret as small firms being constrained to obtain the necessary funds in terms of debt which forces 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.

The empirical evidence suggests that models with a single type firm and only one financing source, is not suitable to understand the relevance of financial frictions over the business cycle for the real economy. Instead a heterogeneous firm model with aggregate shocks is needed where firms must decide between debt and equity financing.

In this paper, we suggest a firm optimization model that is able to explain the facts described in the empirical part. Our model consists of a set of heterogeneous firms that produce with a decreasing returns to scale production technology and receive idiosyncratic and aggregate productivity shocks. The shocks display some persistence, which is important for investment dynamics. The decreasing returns to scale setup allows us to study firm dynamics with entry and exit. Moreover, this assumption generate patterns of investment that are negatively correlated with firm size. Finally, given the stochastic productivity level decreasing returns to scale imply the existence of an optimal firm size. Next, each period firms make a capital structure choice (debt and equity) and an investment decision to maximize equity payout. Adjustments to capital are subject to adjustment costs which we introduce to generate slow convergence to the efficient scale.

While making the capital structure choice firms face the following trade-offs. On the one hand, debt is favored because it is cheaper for a claim holder to invest in debt rather than in equity because of lower tax rates on capital gains. On the other hand, debt financing is costly because debt repayment is not enforceable. The price of debt adjusts to take the likelihood of default into account. The default decision depends on the internal funds, debt to repay, as well as on the shocks. Given the shock and the loan amounts, it is more costly for small firms than for large firms to issue debt because the default probability is higher.

Equity financing is costly for the following reason. When the firm finances with equity, it has to contract underwriters who charge fees. Those fees work at first - that is up to a certain issuance amount - like fixed costs: hence each additional issued dollar before this amount becomes cheaper to finance. However for every dollar beyond that, underwriters charge higher marginal fees. Potentially due to agency problems and because finding more buyers willing to buy the offer at the offer price becomes more difficult. Generally, firms seek to maximize shareholder value, e.g. equity payout. However, if the default probability is too high it can be cheaper for the firm to finance with equity.

Our setup allows for endogenous entry and exit, which in our context would be an IPO. A firm enters the sample and exits when it takes a default decision. Each period potential
entrants receive a signal on their productivity and decide over their entry.

This model succeeds in explaining the correlations we have seen in the data. The mechanism can be boiled down to two major elements. First, firms enter small and decreasing returns to scale imply an efficient scale at which they would like to be right away. When the firms are small their returns to investment are very high. However, capital adjustment costs allow only for a slow convergence to the optimal size. This fact generates that firms have a stronger incentive to seek funds for growth rather than for paying out their shareholders. Shareholders are sufficiently patient to wait for larger payouts in the future when the firm has attained its efficient scale. Second, since small firms want to grow their need of funds is higher. Debt is issued at a premium which is higher for small firms so small firms find it harder to finance their growth with debt. Once debt financing becomes too expensive small firms must use equity instead.

In booms, all firms have more internal funds. Large firms that are closer to their efficient scale use those funds to pay out their shareholders, whereas small firms higher growth opportunities increase their financing needs: as a consequence they seek funds from both equity- and debt holders.

**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)). 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\(^1\).

In the presence of financial frictions, an important determinant of firms’ capital structure choice are macroeconomic conditions. Jermann and Quadrini (2006) find that aggregate debt issuance is pro-cyclical whereas aggregate equity issuance is counter-cyclical. Jermann and Quadrini (2012) build a model to show that financial shocks (in addition to productivity shocks and financial frictions) are necessary to rationalize this cyclical behavior. Hackbarth et al. (2006) build a quantitative model of firms’ capital structure in which financing decisions depend on the business cycle through its effect on default policies.

The macroeconomic literature has mainly focused on representative firm models to un-

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\(^1\)An excellent overview over two decades of research in dynamic corporate finance is provided by Strebulaev and Whited (2012).

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nderstand how financial markets affect the real economy. But macroeconomic shocks affect different firms differently. For instance, Korajczyk and Levy (2003) observe that leverage of financially unconstrained firms varies counter-cyclically. Covas and Den Haan (2011) show that aggregate flow of funds data - as used in Jermann and Quadrini (2012) - is dominated by the largest firms. They find that equity issuance is pro-cyclical except for the largest firms and debt issuance counter-cyclical. We present similar empirical facts but also document how default rates vary with the business cycle and differ across firm size portfolios. Hennessy and Whited (2007) estimate a simulated dynamic model 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.

This 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 et al. (2006) ) to study how credit spreads and the equity premium get determined. This is for example the focus of Bhamra et al. (2010a) who study default and leverage decisions of firms to understand how the business cycle moves credit spreads and the equity premium. Belo et al. (2014) use counter-cyclical equity issuance costs to quantitatively capture firms’ financing and investment behavior as well as asset prices. This paper’s focus is on understanding the determinants of debt- and equity financing over the business cycle decisions. Covas and Den Haan (2012) share our focus on how financial positions move over the business cycle. They 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 endogenous default and endogenous firm dynamics.

The interplay between financial frictions and endogenous firm size dynamics is the subject of another related strand of the literature (e.g. Cooley and Quadrini (2001)). Bergin et al. (2014) find that firm entry dynamics in conjunction with financial frictions are important for the transmission of aggregate shocks. Clementi et al. (2014) study how endogenous entry and exit decisions propagate and reshape aggregate shocks. We follow Clementi and Palazzo (2013) when modeling entry and exit similar. Gomes and Schmid (2012) derive credit spreads from a model with heterogeneous firms and endogenous entry and default. The variation in the distribution of firms, the endogenous aggregate state, stems from firms’ entry and default decisions as well as exogenous variation in firms’ productivity. Firm size is fixed after entry and therefore not used as a dimension of heterogeneity as in this paper.  

2The 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.
We contribute to the literature by analyzing how firm dynamics together with aggregate shocks matter for firms’ financing choices. This is important as firm dynamics determine funding needs and therefore the financing needs of firms. To better understand this linkage can improve our understanding of how aggregate shocks affect firms financing decisions and ultimately also how these financing decisions may amplify aggregate shocks. 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. Section 4 presents the conditions for a stationary firm distribution and discusses the calibration. Section 5 explains the mechanism of the model that derive the results described in section 6.

2 Stylized facts

We document stylized facts 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 but more equity in recessions. 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 from CRSP/Compustat Merged (CCM) Fundamentals Quarterly from the first quarter of 1984 to the last quarter of 2013. 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. Jermann and Quadrini (2006) also show that the period after 1984 saw major changes in the U.S. financial markets.

We confine our analysis to firm size portfolios. This is justified by the work of Hennessy and Whited (2007), who find that external financing costs differ mostly by size. We build size portfolios by sorting firms into quarter and sector specific asset quartiles which

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3The sample selection is described in section A.1.
we henceforth call bins. The composition of firms may therefore change from one quarter to the other. We aggregate the financial variables described below at firm level for each of the four bins.

**Variable Definitions**

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

An equity holder has a claim to funds in form of *equity payout* which we define 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 (prstkey) 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. They include among others the exercise of stock options or warrants as well as stocks issued for an acquisition. These variables are defined on a year-to-date basis. They are converted to quarterly frequency variables by subtracting the past quarter from the current observation for all but the first quarter\(^4\) 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 use Compustat and CRSP data on bankruptcy and firm liquidation. In particular, we count one default event for a firm that was delisted for reasons of bankruptcy or liquidation\(^5\). The *default rate* for a bin is defined as the number of default events within a quarter.

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\(^4\)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.

\(^5\)In Compustat the variable *dlrsn* takes the value of either 02 or 03. In CRSP *dlstcd* is either 574, 574 or 400.
Table 1: Business Cycle Correlation of Equity Payout, Debt Repurchases, and Default

<table>
<thead>
<tr>
<th>Asset Percentile</th>
<th>Equity Payout</th>
<th>Debt Repurchases</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>-0.22</td>
<td>-0.36</td>
<td>0.06</td>
</tr>
<tr>
<td>25-50%</td>
<td>-0.21</td>
<td>-0.67</td>
<td>0.12</td>
</tr>
<tr>
<td>50-75%</td>
<td>0.04</td>
<td>-0.63</td>
<td>-0.19</td>
</tr>
<tr>
<td>75-100%</td>
<td>0.63</td>
<td>-0.52</td>
<td>-0.00</td>
</tr>
<tr>
<td>Aggregate</td>
<td>0.57</td>
<td>-0.55</td>
<td>0.00</td>
</tr>
</tbody>
</table>

We compute the correlations of quarterly real log GDP with the deflated band-passed filtered components of equity payout and debt repurchases, scaled by the trend of assets. We use the band-passed filtered component of default rates to compute the correlation with GDP. The numbers in bold are significant at the 5% level.

For the correlation statistics, we apply the band-pass filter to the deflated bin variable and scale it by the trend component of assets aggregated to the specific bin level. For means and pictures, we use the seasonally smoothed variables and scale it by assets.

2.2 Facts

Equity payout, debt repurchases, and default over the business cycle

Table 1 documents the facts on the business cycle correlations of financial variables and default rates 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. Covas and Den Haan (2011) present similar results. Default rates are acyclical except for firms within the 50-75 percentile of assets that present with counter-cyclical default rates. Table 2 shows that all but the largest firms finance on average with both equity and debt. In contrast, large firms payout to shareholders 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.

Figure 1 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 2013. 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
Table 2: Means

<table>
<thead>
<tr>
<th>Asset Bin</th>
<th>Equity Payout</th>
<th>Debt Rep.</th>
<th>Default in %</th>
<th>Assets*</th>
<th>Sales *</th>
<th>Leverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>−2.81</td>
<td>−0.98</td>
<td>4.89</td>
<td>233</td>
<td>0.70</td>
<td>0.20</td>
</tr>
<tr>
<td>25-50%</td>
<td>−1.37</td>
<td>−1.38</td>
<td>5.43</td>
<td>1092</td>
<td>3.16</td>
<td>0.22</td>
</tr>
<tr>
<td>50-75%</td>
<td>−0.33</td>
<td>−1.90</td>
<td>4.48</td>
<td>3921</td>
<td>10.88</td>
<td>0.27</td>
</tr>
<tr>
<td>75-100%</td>
<td>0.84</td>
<td>−1.68</td>
<td>2.13</td>
<td>58545</td>
<td>123.37</td>
<td>0.28</td>
</tr>
</tbody>
</table>

The variables equity payout and debt repurchases are deflated with the PPI and scaled by $100 of assets. The default rates are the percentage of default events divided by the number of firms within a bin and a quarter. Units marked by * are in millions.

Figure 1: Debt Repurchases and Equity Payout (Business Cycle Frequency)

Figure 1 shows the debt repurchases and equity payout over time for both small and large firms. The two panels depict the repurchase and payout trends across different years, highlighting the cyclical nature of these financial decisions.

Source: Compustat

Our results indicate that there is no clear substitution pattern for equity payout 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 2) of debt repurchases and equity payout is almost identical to the right panel of figure 1. That is, as shown in table 1, the aggregate firm financing patterns are governed by large firms. Focusing on aggregate data only conceals the financing behavior of the majority of firms as the very large firms dominate smaller ones. A representative firm model fitted to aggregate data is therefore representative of large firms. The financing behavior of small and large firms, however, differs significantly over the business cycle, suggesting that firms of different sizes face different or differently strong financing frictions. For this reason, we find a heterogeneous firm financing model more suitable in explaining the impact of financial markets on firm finances and eventually their real behavior. Our model advances a mechanism to explain these financing differences and therefore sheds light on the nature of the financing frictions firms face.
Figure 2: AGGREGATE DEBT REPURCHASES AND EQUITY PAYOUT AT BUSINESS CYCLE FREQUENCY

Source: Compustat
Figure 3: Sales Growth (Business Cycle Frequency)

Table 3: Sales Growth

<table>
<thead>
<tr>
<th>Asset Percentile</th>
<th>Mean</th>
<th>Sales</th>
<th>Sales / T-asset*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>1.69</td>
<td>3.75</td>
<td>0.75</td>
</tr>
<tr>
<td>25-50%</td>
<td>1.48</td>
<td>4.40</td>
<td>0.63</td>
</tr>
<tr>
<td>50-75%</td>
<td>1.44</td>
<td>4.36</td>
<td>0.51</td>
</tr>
<tr>
<td>75-100%</td>
<td>0.98</td>
<td>4.95</td>
<td>0.44</td>
</tr>
<tr>
<td>Aggregate</td>
<td>0.98</td>
<td>4.79</td>
<td>0.42</td>
</tr>
</tbody>
</table>

The standard deviation are for the logged business cycle component of each variable relative to the standard deviation of the logged business cycle component of GDP.

*Sales relative to the trend of assets

Firm Growth

Larger firms are associated with growing less than smaller firms. We look at the firm growth and size relationship in figure 3. We compute sales growth and asset growth for small, large, and the aggregate of firms. The 1990s are marked by large differences in growth between small and large firms. As with the financial variables, also the aggregate time series for assets and sales growth are almost identical to the growth series of the large firms. Table 3 shows that the standard deviation of sales relative to the standard deviation of GDP adjusted for each bins asset trend is decreasing in firm size. If instead we compute the standard deviation of sales relative to the trend of logged assets, we obtain that sales volatility is decreasing in the firm size. That is, adjusting for the different growth rates in firms, smaller firms are more volatile than
larger firms with regard to their sales.

3 The Model

In this section we describe the model environment as well as the problem of incumbent and entrant firms.

There is a continuum of heterogeneous incumbent firms with gross revenue $F(z, s, k) = zsk^\alpha$, where $z$ is the aggregate shock common to all firms and $s$ is the firm specific shock. Firms differ not only with regard to their idiosyncratic productivity $s$, but also with respect to their capital stock $k$ and debt levels $b$. Capital depreciates at the rate $\delta$ each period. Firms own a decreasing returns to scale technology ($\alpha < 1$). The assumption of decreasing returns to scale implies that given the stochastic state, there exists an optimal firm size. 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.

Each period a firm maximizes equity payout to their shareholders by making an investment and a capital structure decision. A firm can finance its operations using debt or equity. Both entail costs which we specify later. When the firm is paying out equity our model does not distinguish between dividends and repurchases explicitly.

3.1 Tax environment

Our model incorporates a rich tax environment to generate features of firms’ decision between equity and debt financing that we see in the data. The two features this specific tax environment generates are the following. First, debt financing has a tax advantage. Second, equity payout is smooth.

We introduce three different taxes: individual, corporate and an equity payout tax. Shareholders are risk neutral and therefore use $\bar{r}(1 - \tau_i) = r$ to discount future cash flow
streams, where \( \tau_i \) is the income tax rate for an investor. Corporate taxable income is equal to operating profits less economic depreciation and interest expense. In our setup the corporate tax bill amounts to

\[
T^c(k, b, z, s) = \tau_c \left[ zsk^\alpha - \delta k - (1 - \frac{1}{1 + r})b \right]
\]

where \( (1 - \frac{1}{1 + r})b \) are the default free interest expenses and \( \delta k \) represent the economic depreciation. Equity payout to shareholders can arise either through repurchase or dividends. Our model does not explicitly distinguish between these two. However, it accounts for the differential tax treatment with an increasing marginal tax rate on equity distribution. We follow Hennessy and Whited (2007) and model the effect of differential tax treatments of dividends and repurchases in a reduced form where the assumed function is convex. This generates a smoothing incentive on cash distributions. Tax liability of all distributions \( X \) amounts to

\[
T^E(X) = \int_0^X \tau_E(x) dx = \int_0^X \tau_E \left[ 1 - e^{\omega x} \right] dx
\]

where \( \omega > 0 \) and \( X > 0 \). Under this assumption \( \frac{\partial T^E(X_0)}{\partial X} = \tau \phi e^{x_0} - \omega x_0 > 0 \) and \( \frac{\partial T^E(X_0)}{\partial X} = \tau X_0 e^{\omega x_0} > 0 \) for all positive distributions. The functional form with increasing marginal tax rates captures well the trade-offs between choosing dividends and repurchases as payout instruments from a tax payers perspective. Dividends are generally taxed at a higher rate than repurchases however SEC and IRS regulations restrict the amount of repurchases as substitution for dividends. If only small amounts of cash flow is distributed, firms use share repurchases. The tax payments will be low because only shareholders who have a low tax-basis will exercise the option of selling their stock to the firm. Then, with increasing cash distributions, the firm has to pay dividends because of these regulatory issues. That is, the firm perceives an increasing marginal tax rate on its cash distributions which we capture by the described functional form.

The tax advantage of debt over equity can be expressed as

\[
\tau_E + (1 - \tau_c) \tau_E > \tau_i.
\]

This states that the total marginal tax rate on corporate earning in form of equity income is higher than the marginal tax rate on corporate earnings packaged as debt (\( \tau_c \) corporation

\footnote{This has somewhat changed since 2003 when tax rates on dividends and equity repurchase income have been equalized.}
3.2 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.

\[ V = \max \{ V^{ND}, V^D = 0 \} \]  

(1)

The repayment value can be represented as a Bellman equation which is composed of equity, \( e \), that is either positive or negative, and the equity issuance or equity payout cost plus the expected continuation value. The states of the repayment value are the two stochastic shocks as well as capital and debt brought in from the last period.

\[ V^{ND}(z, s, k, b) = \max_{k' \in K, b' \in B, e} \left\{ \begin{array}{c}
\text{Equity} \\
\text{Eq.Iss.Cost} \\
\text{Eq.Pay.Cost}
\end{array} \right. \]

\[ + \frac{1}{1+r} E_{s,z} [V(z', s', k', b')] \]  

(2)

The firm maximizes the repayment value by choosing capital and debt to be repaid next period. Both decisions determine equity which is defined as

\[ e = (1 - \tau_c) zsk^\alpha - (k' - (1 - \delta) k) - g(k, k') - c_f + \tau_c \left( \delta k + b(1 - \frac{1}{1+r}) \right) + p^b b' - b. \]  

(3)

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, \( p^b b' \), and less debt to repay, \( b \). In what follows, we define and discuss the debt contract of the model and its the functional forms for the various adjustment costs functions.

The timeline 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.

### 3.3 Adjustment costs

Our model assumes various adjustment costs function whose specific role and form we discuss now. We introduce the adjustment costs for capital to generate slow convergence to the optimal firm size implied by the decreasing returns to scale assumption and idiosyncratic productivity.

Inspired by the empirical investment literature (see Cooper and Haltiwanger (2006)) we have both fixed and smooth capital adjustment costs:

\[
g(k, k') = \Phi_i c_0 k + \frac{c_1}{2} \left( \frac{k' - (1 - \delta)k}{k} \right)^2 k
\]

where \( \Phi_i = 1 \) if investment equals non-zero. The functional form is standard in the empirical investment literature and encompasses both fixed and smooth adjustment costs (convex and non-convex costs). The first component is only active if investment is non-zero. The fixed cost is proportional to the capital stock so that the firm has no incentive to grow out of the fixed cost. The smooth component is captured by the second term. It is responsible to smooth investment over time. The fix part is multiplied by the size of the firm which reflects that large firms usually invest in larger projects, such as building a whole new factory rather than buying an additional machine.

When paying out or issuing equity, the firm incurs cost. Both generate a smooth payout and issuance profile. If equity is positive \( (e > 0) \) it represents a distribution (payout) to the shareholder which is taxable on the shareholder level (see section 3.1). If equity is negative \( (e < 0) \), the firm is issuing shares and therefore finances. In this case, the firms incurs an issuance costs of \( \phi(e) \). This costs is 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 Hennessy and Whited (2007) we capture adverse selection costs and underwriting fees in a reduced form fashion. The external equity cost function is linear and quadratic:

\[
\phi(e(k, k', b, b', z)) \equiv \Phi_e (-\lambda_0 + \lambda_1 e - \frac{1}{2} \lambda_2 e^2)
\]
\[ \lambda_i \geq 0 \quad i = 0, 1, 2 \]

where \( \Phi_e \) equals 1 if \( e < 0 \) and zero otherwise. This functional form is consistent with Altinkilic and Hansen (2000) who find that the cost is U shaped due to fixed costs and increasing marginal fees for large offers. That is, at first average costs are falling because of the fixed cost part dominates the marginal fees. At higher offers the higher fees take over and increase average costs. These parameters are estimated by Hennessy and Whited (2007). They are equivalent to the firm acting as if it faces a fee equal to $83,410 on the first million and $616 for every additional million, amounting to an average fee of $86,109.

### 3.4 Debt Contract and Debt Pricing

In this section we layout the specifics of the debt contract. 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 \( q^b < 1 \). Next period, the firm pays back the face value of the bond \( b' \). 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 residual recuperation value. We follow Hennessy and Whited (2007) by assuming that bondholders obtain the profits for the last operation period, as well as the remaining assets of the company less a deadweight bankruptcy cost. The recuperation value is

\[
RC(k', s', z') = (1 - \varepsilon)[(1 - \delta)k' + (1 - \tau_c)z's'k^{\alpha} + \tau_c \delta k']
\]

where \( \varepsilon \) are interpreted as bankruptcy costs, e.g. any costs related to the liquidation and renegotiation of the firm after default.

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. That is \( \Delta(k, b) = \{ (s, z) \ s.t. \ V^{ND}(z, s, k, b) \leq 0 \} \). Risk neutral investors price debt in the following way:

\[
(1 + r)b' = (1 - Pr_{s,z}(\Delta(k', b'))) (1 + r^b) b' + Pr_{s,z}(\Delta(k', b')) E_{s,z}(RC(k', s', z'))
\]
\[
q^b \equiv \frac{1}{1 + r^b}
\]

\[
q^b(z, s, k', b') = \frac{1 - Pr_{s,z}(\Delta(k', b'))}{1 + r - Pr_{s,z}(\Delta(k', b'))} \frac{RC(k', s', z')}{b'}
\]  

(7)

If the firm does not default for sure the price is just \(\frac{1}{1+r^b}\). 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 repaid 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 shocks the higher the debt capacity of the firm for a given amount of capital. It is important to point out 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.

3.5 Entrant Firm Problem

Here we turn to the entrant problem. In order to tie our model to the data we analyze, we interpret entry as the decision of a firm to go public. Every period there is a constant mass \(M\) of potential entrants who receive a signal \(q\) about their productivity. We specify this signal as Pareto, \(q \sim Q(q)\), with parameter \(\epsilon\) that makes entrants heterogeneous. Firms have to pay an entry fee \((c_e > 0)\) which guarantees that not all firms find it optimal to enter. Consequently it helps to pin down the size distribution of the entering firms.

The entrant only starts operating next period but must decide today with which capital stock it wants to start production tomorrow. This initial investment can only be financed 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

\[
V_e(z, q) = \max_{k'} \left\{ -k' + \phi(-k') + \frac{1}{1 + r} E_{q,z}[V(z', s', k', 0)] \right\}.
\]  

(8)
Entrant invests and starts operating if and only if $V_e(z, q) \geq c_e$.

4 Optimization, Stationary Firm Distribution and Calibration

In this section we define the stationary distribution for this firm optimization problem.

4.1 Optimality Conditions

The incumbent solves the problem described in 1. We state first order conditions with respect to

equity:

$$1 + \Phi_e(\lambda_1 - \lambda_2) - \Psi(\tau_E - \tau_E \exp^{-\phi_{et}}) - \eta = 0$$

where $\eta$ is the Lagrange multiplier.

capital tomorrow:

$$-\eta \left(1 + \frac{\partial g(k', k)}{\partial k'} + b' \frac{\partial q^{b'}}{\partial k'}\right) + \frac{1}{1 + \tilde{r}} E[V_k(z', s', k', b')] = 0$$

debt to be repaid tomorrow:

$$\eta \left(q^b + b' \frac{\partial q^b}{\partial b'}\right) + \frac{1}{1 + \tilde{r}} E[V_b(z', s', k', b')] = 0.$$

The two envelope conditions are:

$$V_k(z, s, k, b) = \eta \left[(1 - \tau_c) F_k(z_t, s_t, k_t) - \frac{\partial g(k', k)}{\partial k} + 1 - \delta (1 - \tau_c)\right]$$

$$V_b(z, s, k, b) = -\eta (1 - \tau_c(1 - \overline{q}))$$

Summarizing the optimization at an interior solution:

$$\eta = 1 + \Phi_e(\lambda_1 - \lambda_2) - \Psi(\tau_E - \tau_E \exp^{-\phi_{et}})$$

$$\left(1 + \frac{\partial g(k', k)}{\partial k'} + b' \frac{\partial q^{b'}}{\partial k'}\right) = E\left(\frac{\eta'}{\eta(1 + \tilde{r})}\right) \left[(1 - \tau_c) F_k(z', s', k') - \frac{\partial g(k', k')}{\partial k'} + 1 - \delta (1 - \tau_c)\right]$$
\[
(q + b \partial q^h = \frac{(1 - \tau_e(1 - \eta))}{1 + \tilde{r}} E \left[ \left( 1 + \Phi_e(\lambda_1 - \lambda_2) - \Psi(\tau_E - \tau_E e^{-\omega_e}) \right) \right]
\]

(13)

4.2 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 \( S \times K \times B \times \mathbb{R} \times \mathbb{R}^+ \) and \( \forall t \geq 0 \),

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

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

4. For all Borel sets \( S \times K \times B \times \mathbb{R} \times \mathbb{R}^+ \) and \( \forall t \geq 0 \),

\[
\Gamma_{t+1}(S \times K \times B) = \int_S \int_{B(K, B, z)} d\Gamma_1(k, b, s) dH(s'/s) + \varepsilon_{t+1}(S \times K \times B)
\]

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

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.

4.3 Parametrization

We use parameters that are standard in the literature and estimate the aggregate shock to match quarterly US GDP. We look for a stationary distribution of firms. This means that entry and exit parameters are calibrated to achieve this goal.
### Table 4: Quantification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Function</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha = 0.65 )</td>
<td>production function</td>
<td>HW2007</td>
</tr>
<tr>
<td>( \delta = 0.025 )</td>
<td>depreciation</td>
<td>NIPA depreciation</td>
</tr>
<tr>
<td>( c_0 = 0.039 )  ( c_1 = 0.049 )</td>
<td>inv. adjust.</td>
<td>CH2006</td>
</tr>
<tr>
<td>( r = 0.01 )</td>
<td>riskless rate</td>
<td>implies 4% annual r</td>
</tr>
<tr>
<td>( \tau_i = 0.29 )</td>
<td>ind. tax rates</td>
<td>Graham2000</td>
</tr>
<tr>
<td>( \tau_e = 0.12 )</td>
<td>payout tax rates</td>
<td></td>
</tr>
<tr>
<td>( \tau_c = 0.25 )</td>
<td>corp. tax rates</td>
<td></td>
</tr>
<tr>
<td>( \omega = 0.732 )</td>
<td>cash dist. tax</td>
<td>HW2007</td>
</tr>
<tr>
<td>( \lambda_0 = 0.389 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \lambda_1 = 0.053 )</td>
<td>cost for equity iss.</td>
<td>HW2007</td>
</tr>
<tr>
<td>( \lambda_2 = 0.0002 )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \varepsilon = 0.1 )</td>
<td>lost in default</td>
<td>HW2007</td>
</tr>
<tr>
<td>( c_e = 0.4427 )</td>
<td>entry parameters</td>
<td>entry of 3%</td>
</tr>
<tr>
<td>( M = 4100 )</td>
<td>mass of entrants</td>
<td>entrants’ rel size (18%)</td>
</tr>
<tr>
<td>( c_f = 0.07 )</td>
<td>fixed cost of operation</td>
<td>exit of 3%</td>
</tr>
<tr>
<td>( \rho_s = 0.94 )</td>
<td>idiosy. shock per</td>
<td>stay bin transition prob.</td>
</tr>
<tr>
<td>( \sigma_s^2 = 0.06 )</td>
<td>idiosy. shock vol</td>
<td>move one bin transition prob.</td>
</tr>
<tr>
<td>( \rho_z = 0.8857 )</td>
<td>persistence</td>
<td>U.S. quarterly GDP</td>
</tr>
<tr>
<td>( \sigma_z^2 = 0.0093 )</td>
<td>standard deviation</td>
<td>U.S. quarterly GDP</td>
</tr>
</tbody>
</table>

For the idiosyncratic shock we convert the annual parameters used by Clementi and Palazzo (2013) into quarterly. We follow Cooper and Haltiwanger (2006) for the adjustment cost of investment parameters \( (c_0 \text{ and } c_1) \) and Hennessy and Whited (2007) for fraction lost in default, equity issuance and payout costs parameters \( (\lambda_0, \lambda_1, \lambda_2, \omega \text{ and } \varepsilon) \).

### 5 Main Mechanism

So far we have described a firm optimization model. Now, we describe the interplay of the model ingredients 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 default premium on debt:

1: **Firm dynamics**: There is endogenous entry and exit. More firms enter in good times. Those firms tend to be small. They want to grow and therefore have large financing
2: Decreasing returns to scale: 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. A potential entrant cannot borrow hence it enters small, far away from its efficient scale. It would like to invest to be closer to the efficient scale in the next period. With adjustment costs, however, it takes several periods before the optimal size is attained. In other words, firms grow slowly towards their efficient scale. This is important because a small firm has a stronger incentive to seek funds for growth than for paying out to shareholders. In our setting, shareholders are sufficiently patient to wait for future payouts once the firm has attained its efficient scale.

3: Debt pricing depends on default probability and collateral: Debt is issued at a premium that depends on the likelihood of default. The likelihood of default is higher, the lower internal revenues, the higher the loan, and the worse the aggregate and idiosyncratic productivity.

In the model, firms enter small, in particular in good economic times. Figure 4 plots the average firm size distribution over the normalized assets for different states in the economy. In the boom state, more small firms enter. Moreover, the distribution is flatter: the large firms are larger compared to bad states during which the size distribution becomes more concentrated. The fact that small firms enter more during booms increases the financing needs of the small firm bin size.

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. We see that feature in the data too. Recently AT&T issued debt in order to repurchase shares which is just another form of payout.

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 5, plots external
needs of funds \((1 - \tau_c) z s k^{\alpha} - (1 - \delta) k + \tau_c \delta k - g(k, k') - c_f - b \left(1 - \tau_c \left(1 - \bar{p}\right)\right)\) in red and optimal investment in blue over debt to be repaid today. The solid line is a recession and the dashed is 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 is closer but above its perfect size. Figure 5 further shows that the more debt a firm must repay the higher its need of funds.

Figure 5 highlights the first part of our mechanism. Smaller firms have higher needs of funds than large firms due to the decreasing returns to scale technology. In this example the large firm must even deinvest to stick to its optimal size. This can happen when the firm had a higher idiosyncratic productivity in the previous period. The small firm has always a positive and higher need of funds when compared to the large for any given amount of debt to be repaid. This is because they have lower internal funds and higher investment needs. Moreover, the graph shows how the business cycle amplifies the mechanism of the model: when comparing the two graphs, the needs of funds of small firms is much more responsive to the business cycle.

The last feature of the mechanism relates to firm financing. Suppose a firm intends to increase capital by one unit and must decide how to finance this unit. If it increases debt while increasing probability of default - this happens if the firm is close to the default region
- the 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 for this extra unit of equity (lower e) which decreases the firm’s value.

The Euler equation for capital (12) shows how investing an additional amount of capital gives returns from tomorrow’s production and from having extra internal funds that could be used to pay off future debt. This is because $\frac{\partial q^b}{\partial k'} > 0$, since the higher $k'$, the lower the probability of default, so the higher the price. Further, the probability of default depends on the aggregate conditions. Figure 6 depicts the price of debt as a function of collateral (firm assets) for different aggregate shocks. The better the aggregate condition, the less capital collateral is needed for the same price of debt.

The Euler equation for debt (13) 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 7 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 productivity. These firms share 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. For a small firm,
Figure 6: Price of Debt

![Figure 6: Price of Debt](image)

Figure 7: Price of Debt

![Figure 7: Price of Debt](image)
the top panel, there exists an 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. In contrast, the debt ceiling of a large firm is higher and therefore gives the firm cheaper access to debt financing.

Firms with high funding needs but relatively low debt ceilings may find it cheaper to finance with equity. Figure 8 plots the marginal costs of equity and debt financing for small (left panel) and large firms (right panel). Since small firms have relatively higher needs of funds and face higher debt financing costs, they resort to equity. As the marginal cost of debt slopes up after the debt ceiling is reached, the marginal cost of equity becomes lower than debt marginal cost of debt. Large firms only finance with equity if they need a lot of funds which is not the case. In booms small firms have even higher needs of funds, hence they will issue even more equity.

The mechanism relies on higher funding needs by small firms. The price of debt adjusts to the default probability, which is higher the more leveraged the firm is. In the model, small firms lever up (to finance their growth) until they hit the debt ceiling. Therefore this mechanism will not explain why in the data small firms have lower leverage than large firms.
### Table 5: Business Cycle Correlation of Financial Variables

<table>
<thead>
<tr>
<th>Bin</th>
<th>Equity Pay</th>
<th>Debt Rep</th>
<th>Equity Pay</th>
<th>Debt Rep</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>−0.22</td>
<td>−0.36</td>
<td>−0.48</td>
<td>−0.61</td>
</tr>
<tr>
<td>25-50%</td>
<td>−0.21</td>
<td>−0.67</td>
<td>−0.28</td>
<td>−0.60</td>
</tr>
<tr>
<td>50-75%</td>
<td>0.04</td>
<td>−0.63</td>
<td>−0.09</td>
<td>−0.69</td>
</tr>
<tr>
<td>75-100%</td>
<td>0.63</td>
<td>−0.52</td>
<td>0.16</td>
<td>−0.41</td>
</tr>
</tbody>
</table>

#### 6 Results

The optimization generates policies for every state that defines firms. We simulate these firms for a large number of periods, allowing for entry and exit according to the firm distribution discussed in section 4. We discard the first half of the simulation and treat the data the same way as we treat 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. The results are presented in table 5. It shows that the mechanism is able to generate similar patterns to the data. As equity payout is counter-cyclical for the first three bins and pro-cyclical for the last bin (large firms). Debt repurchase is counter-cyclical for everyone as in the data.

This is because small firms need more funds in booms and are unable to finance this large amount with bonds. Then they must issue more 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.

#### 7 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.

Our model highlights the importance of different funding needs over the different growth stages of firms. 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. The model proposes an explanation for the cyclical movements and the cross-sectional differences of firm financing. Going forward, our analysis suggests that the interplay between firm dynamics and financial frictions are important to understand firms’ financial positions and investment behavior over the business cycle.
References


A Appendix

A.1 Data

We download the Compustat/CRS merged data file from the first quarter in 1978 until the last quarter in 2013 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 discard 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 these 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 2013. 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.

A.2 Definitions

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).

A.3 Empirical Results

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.
Table A1: Include first quarter of new firms

<table>
<thead>
<tr>
<th>Asset Percentile</th>
<th>Equity Payout</th>
<th>Debt Repurchase</th>
<th>Default in %</th>
<th>Correlation with quarterly</th>
<th>GDP ( real log )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>-0.0309</td>
<td>-0.0103</td>
<td>4.83</td>
<td>-0.16</td>
<td>-0.38</td>
</tr>
<tr>
<td>25-50%</td>
<td>-0.0158</td>
<td>-0.0142</td>
<td>5.43</td>
<td>-0.19</td>
<td>-0.70</td>
</tr>
<tr>
<td>50-75%</td>
<td>-0.0040</td>
<td>-0.0192</td>
<td>4.49</td>
<td>-0.06</td>
<td>-0.61</td>
</tr>
<tr>
<td>75-100%</td>
<td>0.0082</td>
<td>-0.0165</td>
<td>2.13</td>
<td>0.67</td>
<td>-0.53</td>
</tr>
</tbody>
</table>

Table A2: Excluding first year of new firms

<table>
<thead>
<tr>
<th>Asset Percentile</th>
<th>Equity Payout</th>
<th>Debt Repurchase</th>
<th>Default in %</th>
<th>Correlation with quarterly</th>
<th>GDP ( real log )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>-0.0309</td>
<td>-0.0103</td>
<td>4.83</td>
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<td>-0.0158</td>
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<td>-0.0040</td>
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<td>0.0082</td>
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<td>2.13</td>
<td>0.67</td>
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</tr>
</tbody>
</table>

Table A3: Excluding first two years of new firms

<table>
<thead>
<tr>
<th>Asset Percentile</th>
<th>Equity Payout</th>
<th>Debt Repurchase</th>
<th>Default in %</th>
<th>Correlation with quarterly</th>
<th>GDP ( real log )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>-0.0057</td>
<td>-0.0013</td>
<td>-0.0013</td>
<td>-0.2436</td>
<td>0.1584</td>
</tr>
<tr>
<td>25-50%</td>
<td>-0.0018</td>
<td>-0.0026</td>
<td>-0.0017</td>
<td>-0.2746</td>
<td>-0.3563</td>
</tr>
<tr>
<td>50-75%</td>
<td>0.0021</td>
<td>-0.0044</td>
<td>0.4117</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75-100%</td>
<td>0.0084</td>
<td>-0.0048</td>
<td>0.5850</td>
<td></td>
<td>-0.2576</td>
</tr>
</tbody>
</table>
### A.4 Additional Facts

**Table A4: Business Cycle Correlations**

<table>
<thead>
<tr>
<th>Asset Percentile</th>
<th>ΔCash</th>
<th>Equity Issu.</th>
<th>Sale$^{13}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-25%</td>
<td>0.05</td>
<td>0.30</td>
<td>0.38</td>
</tr>
<tr>
<td>25-50%</td>
<td>0.03</td>
<td>0.34</td>
<td>0.61</td>
</tr>
<tr>
<td>50-75%</td>
<td>−0.17</td>
<td>0.34</td>
<td>0.72</td>
</tr>
<tr>
<td>75-100%</td>
<td>−0.38</td>
<td>0.44</td>
<td>0.63</td>
</tr>
<tr>
<td>Aggregate</td>
<td>−0.36</td>
<td>0.43</td>
<td>0.65</td>
</tr>
</tbody>
</table>

We compute the correlations of quarterly real log GDP with the deflated band-passed filtered components 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.