Credit Constraints and Firm Dynamics*

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We develop a general equilibrium model that links entry barriers, firm dynamics and borrowing constraints. In the model, firms borrow to finance entry cost and extra investment above net profits. To borrow, firms post collateral that depends on their future capital stock. Firms also face idiosyncratic productivity shocks every period. The borrowing constraint and entry barrier have an effect on firm dynamics. This has aggregate implications for productivity and income differences across countries. A country with lower financial development faces tighter borrowing constraint that leads to lower aggregate productivity and income.

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1 Introduction

The growth accounting literature attribute to differences in aggregate total factor productivity (TFP) as the main source of the large variation on income across countries. There is a growing literature that emphasizes the importance of factor reallocation for TFP and output growth (see-Olley and Pakes (1996), Foster et al. (2006),Griliches and Regev (2006), Bartelsman et al. (2004), Aghion and Howitt (2006)). Among the factors that drive resource reallocation are technological adoption by incumbents and firm dynamics, ie: entry, growth post entry and exit of non productive firms. Two key factors that have been emphasized as barriers to entry are administrative costs for creating new firms (Djankov et al. (2002)) and product and labor market regulation (Lewis (2004), Fang (2009)), Parente and Prescott (1994),Herrendorf and Teixeira (2009)). There is also a vast literature that examines the link between financial development and economic development. Low financial development is negatively correlated with GDP per capita and TFP[1].

This paper develops a general equilibrium model to analyze the effects of high entry barriers and low financial development on aggregate TFP and GDP per capita. The framework is the firm dynamics model of Hopenhayn (1992) and Hopenhayn and Rogerson (1993). Incumbents firms receive productivity shocks and make investment decisions every periods. Investment is financed by retained earnings and external financing. External financing is obtained through one-period debt. In the case that the borrower is unable to pay the lender can liquidate the firm. However, in the liquidation process only a fraction of non-depreciated capital can be saved. Therefore, the debt is constrained by the maximum of non depreciated future capital that can be recovered. Also, firms can enter each period by paying entry cost which is financed by borrowing.

Variations in the borrowing constraint and entry cost will be used to assess the quantitative importance of these two channels. We will first vary them individually then together to assess the interaction of financial constraints and entry barriers. The finan-

[1]See e.g Goldsmith (1969), McKinnon (1973), Shaw (1973),King and Levine (1993), Beck et al. (2000), Levine (2005).

cial constraint limits firms' growth by limiting investment and entry even in the case of same entry cost. Credit access as a barrier to entry has been found to be empirically important by Aghion et al. (2007). The financial constraint can also lead firm to exit in the case of low productivity shock. High entry costs lead to low entry and low initial investment. The two channels interact to yield low aggregate productivity and output.

These channels have been individually used to explain cross-country income differences. Starting with the seminal work of Parente and Prescott (1994), many authors used entry barriers as a source of TFP differences. One strand of the literature (Herrendorf and Teixeira (2009)) posit that monopoly rights in the labor market can prevent the adoption of new technology. They show that this channel have a sizable impact of TFP differences across countries. Fang (2009) examines barriers to entry in the product market as a driving force for TFP differences[2]. She finds that high entry barriers lead to less competition and to the adoption of less productive technologies and the quantitative effect on TFP can be sizeable. The role of financial development as a source of income and productivity differences has been explored by many authors. The qualitative link has been established number of theoretical models[3]. Amaral and Quintin (2007) quantifies a general equilibrium model that shows poor financial development through low degree of contract enforcement is important for accounting for the income gap across countries.

Our paper quantifies the importance of these two channels in a single general equilibrium model. The effects of high entry barriers are magnified by the financial constraint. We calibrate the model to match key aggregate and industry variables in the US economy. We then use the entry costs and debt recovery rates found in developing countries to evaluate the implications of the model. We find that these two channels can account for a sizable difference of income and aggregate TFP differences across countries.

In addition to the papers discussed above, our paper is related to the literature on investment dynamics in the finance literature. In this literature, investment is financed trough internal and external sources. Internal financing is done through retained earnings

[2]In Aghion et al. (2009), the authors explores how entry barriers can affect incumbent technology choice in developed countries.

[3]See e.g. Greenwood and Jovanovic (1990),Bencivenga and Smith (1991), Khan (2001), Erosa and Hidalgo (2005).

while external financing take the form of issuing new shares and borrowing. External financing is usually costlier than internal financing and therefore is less preferred. However, most of the models in this literature are a partial equilibrium analysis and the questions addressed are firm behavior in developed countries[4]. Another strand of the literature look at the effect of financial frictions in explaining firm dynamics across sectors (e.g Buera et al. (2009)) or across countries (see e.g. Arellano et al. (2009)).

The rest of the paper is organized as follows. Section 2 look at the empirical facts on entry barriers and financial development. Section 3 describes the model and section 4 derive the properties of the stationary equilibrium. In section 5, we calibrate the model to the US and section 6 uses the calibrated model to assess the quantitative importance of high entry costs and tight financial constraints. Financially, section 6 concludes.

2 Empirical Evidence

In this section, we present few empirical facts that have been discussed in the literature.

2.1 Entry Barriers:

The landmark study by De Soto(1990) on entry regulation highlighted the importance of this topic. He pointed out that starting a business is very costly and time consuming. Djankov et al. (2002) examined the number of administrative procedures and the official costs involved in setting up a business. They find that there is huge variation across country. In general, the number of procedures and entry cost is negatively correlated with GDP per capita. **?** focus on OECD countries and find that entry barriers are negatively related to TFP. Barseghyan (2008) finds that an increase in entry costs lower output through a decline TFP. An increase of entry costs by 80% of income per capita lower lead to decline in TFP by 22% and output per worker by 29%.

[4]see e.g Hennessy and Whited (2005), Livdan et al. (2009) for partial equilibrium analysis of stock returns and debt dynamics. Cooley and Quadrini (2001) and Gomes (2001) use GE models to assess the effect of financial frictions or costly external financing on firm investment behavior. Hosono (2009) uses a similar model to assess the effect of the banking crisis in explaining the decline in TFP in Japan in the 1990s. Gourio and Miao (2010) also uses a GE model to asses the long-run effects of dividend tax reforms.

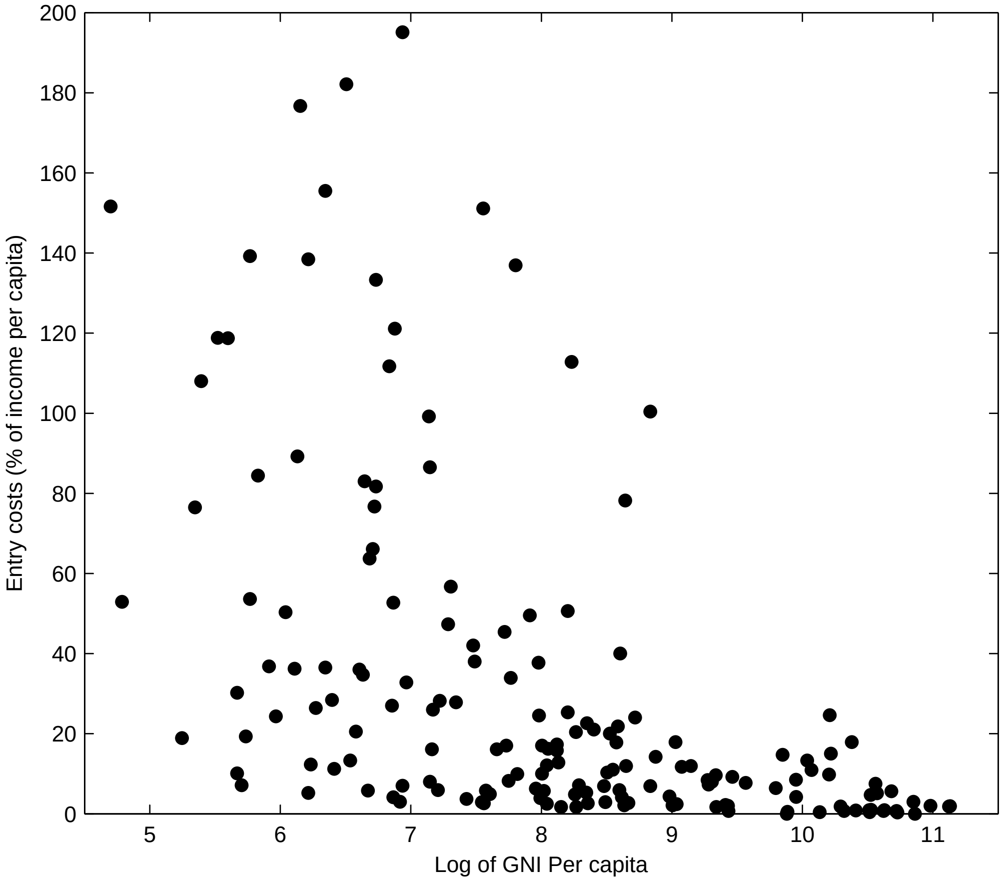

Figure 1: Entry Costs for All Countries

In the two graphs below, we plot entry costs as a percentage income per capita from the "World Bank Doing Business 2010" database against log of gross national income per capita. The first figure present data for 169 developing and developed countries[5]. We see that there is clearly a negative relationship with income per capita.

In the second figure, we plot the data for 44 Sub-Sahara African countries. Nineteen of the countries have entry costs higher income per capita. In contrast, the most successful countries (Botswana, Mauritius and South Africa) have costs under 10% of income per capita. A closer look at the data also reveals that former French colonies have higher costs in general.

[5]We excluded countries with costs more than twice of income per capita.

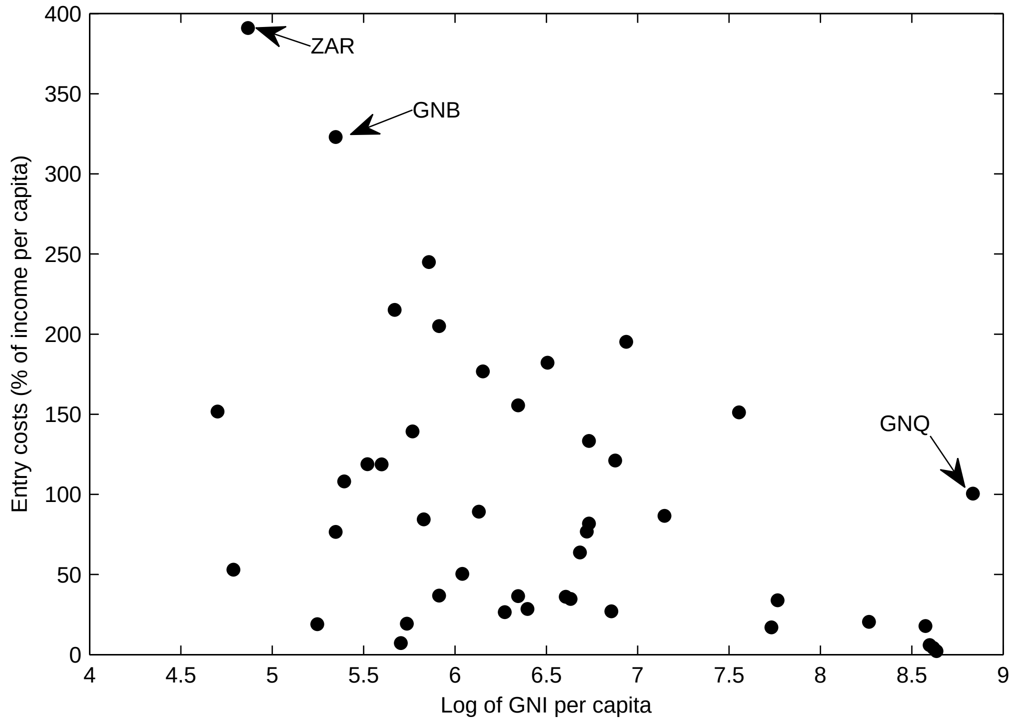

Figure 2: Entry Costs for Sub-Saharan Africa

2.2 Debt enforcement

In a study of debt enforcement in 88 countries around the world, Djankov et al. (2008) find that the process is time consuming (2.64 years on average), costly (14% of the estate) and the business stays together only in 36% of cases. With their measure of efficiency, they find that the world average is 51.97%. Another key finding is efficiency is positively correlated with the level of GDP per capita and depends on the legal origin. The efficiency levels are 77.3% for the richest countries, 46.1 % for the upper-middle-income and 35% for the lower-middle-income countries. Countries with French origin perform the worst in this process. Djankov et al. (2008) also calculates the amount of the date that is recovered at the end of the process (recovery rate). This measure is highly correlated with the efficiency level and is also positively correlated with income per capita. In figure 3, we plot the recovery rates against log of GDP per capita. The positive correlation can be observed despite the fact this cost involved in calculation the recovery rate does not take into account of the time cost.

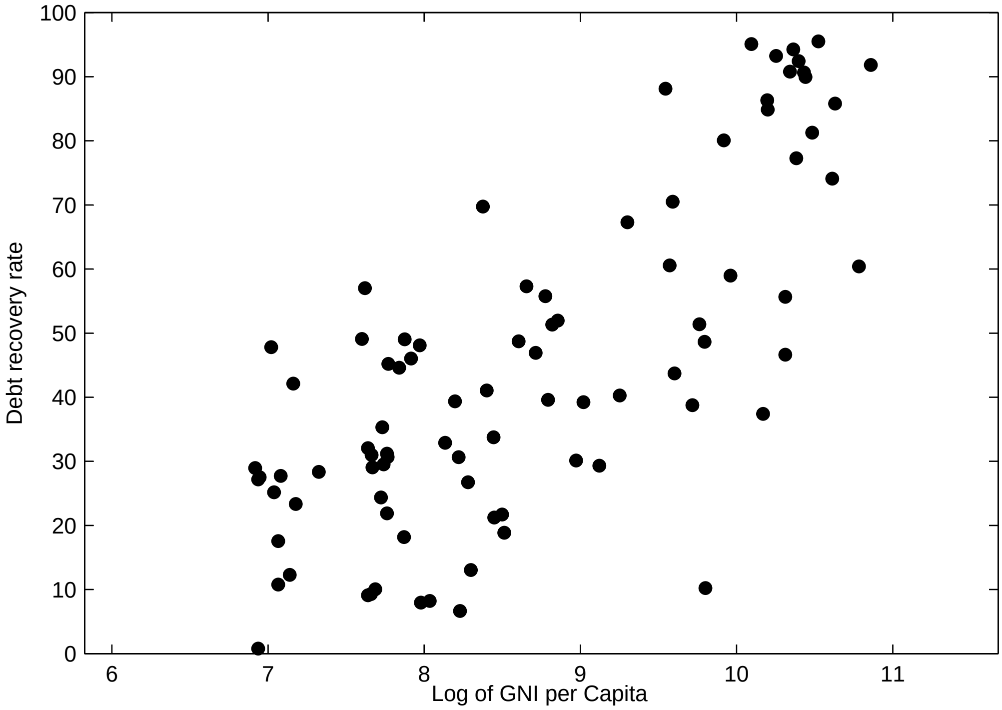

Figure 3: Debt Recovery Rates Across Countries

The variation in the entry costs and debt recovery rates will be used to quantify the importance of the two channels emphasized in this paper.

3 Model

3.1 Production

This section describes the firms in our theoretical framework. The dynamic model for firms follow the framework set out in Hopenhayn (1992) and Hopenhayn and Rogerson (1993). The economy is populated by a continuum of ex-ante identical firms. Firms are either producing or outside of the market and can enter any time. We first describe the behavior of existing firms.

3.1.1 Existing Firms

Existing firms use decreasing returns technology to produce output that can be used for consumption or investment each period. Production is subject to an individual productivity shock which evolves following a common stationary and monotone Markov process. Shocks are uncorrelated across firms. The production technology uses capital and labor as inputs and is given by:

$$y_t = f(k_t, l_t, z_t) = e^{z_t} k_t^{\alpha_K} l_t^{\alpha_L} \tag{1}$$

where y_t, k_t, l_t, z_t are respectively output, capital, labor and productivity shock. The decreasing return property requires that $\alpha_K + \alpha_L < 1$. The transition function, denoted, $Q(z_{t+1}/z)$ satisfies the Feller's property and is is specified as follows:

$$z_{t+1} = \rho z_t + \epsilon_t \tag{2}$$

Production requires the payment of a fixed cost f each period.

Each period, a firm chooses a level of investment i_t to grow its capital stock which evolves as follows:

$$k_{t+1} = (1 - \delta) k_t + i_t \tag{3}$$

We assume that capital is irreversible. This assumption is justified by the fact for many industries there is no secondary market for plant and equipment as they are not easily adaptable for other use. It is also consistent with the evidence presented in Caballero and Engel (1999). By imposing this assumption, we are treating capital as fixed capital only but not inventories. We also impose constraint (4) as it is generally very costly to decrease capital and the costs are particularly higher in developing countries[6]

$$i_t \geq 0 \tag{4}$$

[6] This constraint can be partially relaxed by using different costs for positive and negative investment, see for example Livdan et al. (2009). For Developing countries the assumption will be even more binding.

3.1.2 Entry and exit

Each period, potential entrants draw productivity from the distribution $G(z)$ that is the same each period and independent across entrants. Entry requires the payment of a one-time fixed cost f_e also denominated in units of output. This cost will differ across countries. After entry, new firms are like incumbents with the difference that they have no capital. The entrants has to borrow to finance the entry cost, the initial investment and production cost. Entrants do not produce in the period of entry since they do not have any capital but behave like incumbents afterward.

A firm exits when its expected value is below its next period's capital net of depreciation. When the firm exits, its capital stock is lost[7]

3.2 Financing Investment

Investment can be financed through retained earnings or borrowing. We follow Livdan et al. (2009) to model a single-period debt. Denote b_{t+1} the face value of debt chosen by an individual firm in period t and payable in period $t+1$. Because firms can retain earnings, positive values represent external borrowing while negative values represent retained earnings or savings[8].

When requiring external financing, firms face a borrowing constraint. One of the simplest way to model the borrowing constraint is to assume that firms post a collateral that depends on next period's capital net of depreciation. Specifically,

$$b_{t+1} \leq \begin{cases} b_e + \phi(1-\delta)k_{t+1} & \text{for new entrants} \\ \phi(1-\delta)k_{t+1} & \text{for existing firms} \end{cases} \tag{5}$$

where $0 < \phi < 1$ is a constant parameter that will vary across countries. This means that when a firm exits, lenders can take over the firm at some cost $((1-\phi)(1-\delta)\phi)$. The distinction between entrants and existing firms is necessary because entrants cannot

[7]This can be easily changed by the aggregation of capital.

[8]We do not model specifically financial intermediation. We assume that there are a large number of risk neutral financial intermediaries and they behave competitively. They take deposits for savers and lend to borrowers.

issue equity and do not come with their own savings[9]. The parameter b_e may be another source of cross-country differences as lending to new firms may depend on a country's level of financial development. For new entrant to undertake positive investment, the constraint $b_e > f_e + f$ has to hold.

This formulation of the borrowing constraint is similar to that of Livdan et al. (2009), Hennessy and Whited (2005) and others. With the collateral constraint, lending is not a risky activity as lenders always get paid in full. So lenders will be paid the risk free interest rate ($r_b = r_f$) and borrowers get the inflow of of b_{t+1}/r_b.

The alternative formulation for borrowing constraint is to assume that there is imperfect contract enforcement so borrowers can default or asymmetric information where lenders don't observe the borrowers output or profits. Both cases will lead to a limit on the amount borrowed[10].

As mentioned above the other way of financing investment is through retained earnings. However, the firm is not indifferent between the two financing options because of the borrowing constraint. Let r_s be the interest rate on savings. We follow the literature (see Cooley and Quadrini (2001), Livdan et al. (2009))and assume this rate is lower than the borrowing rate. Specifically,

$$r_s = r_b - \kappa \tag{6}$$

This assumption has been justified by different arguments. If the two interest rates are equal, then firms will always retain all earnings and never distribute dividends. This is contrary to the evidence. Also, their is a different tax treatment between retained earnings and interest on debt. Retained earnings are disadvantaged in the US tax system. A third argument is that if we start with equal interest rates this will lead to an over supply of loanable funds which will ultimately interest on savings to be lower.

Let the λ_b be an indicator for positive debt. The effective interest rate for an individual

[9]An equivalent way to model this is to think firms as entrepreneurs that can start firms with their own savings and some borrowing. Albuquerque and Hopenhayn (2004) adopt this formulation and requires entrepreneurs to borrow when starting the project as initial cost is higher than self-funding. The implication of the formulations are similar

[10]See e.g. Cooley and Quadrini (2001), Buera et al. (2009), Arellano et al. (2009).

firm from period t to $t+1$ is:

$$r = \lambda_b r_b + (1 - \lambda_b) r_s. \tag{7}$$

3.2.1 Timing

At the beginning of period t, each incumbent has capital k_t and debt level b_t. The firm observes the realization of its productivity shock then hires labor, pays the fixed cost and produces. From the sales of output, the firm pays wages, decides on the investment and future debt and pays dividend. At the end of the period, the firm decides to stay or exit for next period.

The potential entrants decide to enter or stay out. If a firm enters, it pays entry cost, observes its productivity and then makes the investment and borrowing decision. This timing follows Gomes (2001) and it implies that there may be a lot of heterogeneity for new entrants which is consistent with the findings of Dunne (1994).

3.3 Household

There is a representative household with preferences defined over a single consumption goods c given by:

$$\sum_{t=0}^{\infty} \beta^t log(c_t) \tag{8}$$

where β is the discount factor. The household owns all firms, therefore receive all the dividend income. The household is endowed with one unit of labor in every period that is used for work. We assume that the household does not value leisure.

4 Equilibrium

Each period, a firm can be summarized by its, capital level, outstanding debt (or saving) and productivity shock (k, b, z). Let w be the wage rate and $\pi(k, z; w)$ be the profit before the investment decision. We normalize the price of the final output to 1.

$$\pi(k, z; w) = \max_{l} zk^{\alpha_K} l^{\alpha_L} - wl - f$$

The first order condition gives the labor demand function:

$$l(k, z; w) = \left(\frac{\alpha_L z k^{\alpha_K}}{w} \right)^{\frac{1}{1-\alpha_L}} \tag{9}$$

Then,

$$y(k, z; w) = (zk^{\alpha_K})^{\frac{1}{1-\alpha_L}} \left(\frac{\alpha_L}{w} \right)^{\frac{\alpha_L}{1-\alpha_L}} \tag{10}$$

$$\pi(k, z; w) = (1 - \alpha_L)(zk^{\alpha_K})^{\frac{1}{1-\alpha_L}} \left(\frac{\alpha_L}{w} \right)^{\frac{\alpha_L}{1-\alpha_L}} - f \tag{11}$$

The objective of an individual firm is to maximize discounted lifetime dividend. The problem can be formulated as follows:

$$\max_{k_{t+1}, b_{t+1}} E_0 \sum \frac{1}{(1+r)^t} d_t \tag{12}$$

subject to:

$$\frac{b_{t+1}}{1+r} - d_t = i_t - (\pi(k, z; w) - b) \tag{13}$$

$$d_t \geq 0 \tag{14}$$

and the investment constraints (3, 4) and the collateral constraint (5).

Equation 13 is the flow of funds constraint. The left hand side represents the source of external funding net of dividend payment d_t. On the right hand side, we have the investment gap which is the extra investment that cannot be covered by internal fund. We impose a positive dividend constraint (14) as firms are not allowed to issue shares. If the investment gap is negative, the firm is unconstrained and can pay positive dividend. But if it is positive the firm borrows to invest and does not pay dividend. Therefore a constrained firm will not pay dividend as the borrowing cost is more than the benefit from dividend.

We can rewrite the firm's problem in a dynamic form as follows:

$$
\begin{aligned}
v(k,b,z;w) \quad &= \quad \max_{k',b'} \pi(k,z;w) + \frac{b'}{1+r} - b - (k' - (1-\delta)k) + &(15)\\
&\quad \frac{1}{(1+r)^t} \max \left[\int v(k',b',z';w)Q(z,dz'), (1-\delta)\phi k' \right] &(16)
\end{aligned}
$$

subject to constraints (14), (4) and (5)

The dividend and flow of funds constraints lead to a limit on borrowing or lending for a given k':

$$
b' \leq (1+r)(\pi(k,z;w) - b + (1-\delta)k - k') \tag{17}
$$

If the investment gap is negative, the retained earning cannot exceed the absolute value of the right hand side of this equation. Also, with the collateral constraint, we get an upper bound of next period's capital.

$$
k' \leq ((1-\delta)k + \pi(k,z;w) - b)/(1 - \phi(1-\delta)/(1+r_b)) \tag{18}
$$

Proposition 1: v is unique, continuous and increasing in z and k and continuous and decreasing in b. Also v is differentiable in its first and second arguments if the dividend constraint is not binding.

The proof of this proposition follows the arguments in Gomes (2001) and Hennessy and Whited (2005). The proposition guarantee the existence of a solution with three decision rules: capital accumulation $k(k,b,z;w)$, borrowing decision $b(k,b,z;w)$ and exit decision $x(k,b,z;w)$ where $x=0$ corresponds to stay and $x=1$ corresponds to exit. A firm exits if its expected future dividends is below its debt repayment value:

$$
\int v(k',b',z';w)Q(z,dz') \leq (1-\delta)\phi k' \tag{19}
$$

Since v is an increasing function in z' and Q is monotone, the exit decision can be summarized by a threshold value of the idiosyncratic productivity level. The exit decision can be described as follows.

$$x(k, b, z; w) = \begin{cases} 1 & z \geq z^* \quad \text{(stay)} \\ 0 & z < z^* \quad \text{(exit)} \end{cases} \tag{20}$$

To determine the equilibrium wage level, we use the free entry condition: Free entry implies that

$$\int v(0, 0, z; w) G(dz) = f_e \tag{21}$$

4.1 Impact of the Borrowing Constraint

As we mentioned before, a constrained firm does not pay dividend but borrows to invest. On the hand, when the firm has retained earnings, it can pay positive dividend. Given the interest rate differential, retained earnings are preferred to debt. In addition, the investment policy depends not only on capital and productivity shock but also on the current level of debt. A firm with higher debt invests less than an otherwise similar firm. As equation (18) shows, there is limit on next period's capital. Also, if two firms have the same capital and productivity shock, the firm with higher debt will borrow more if the two choose the same capital next period. $\frac{\partial k'}{\partial b} \leq 0$ for fixed k and z. $\frac{\partial b'}{\partial b} \geq 0$ for fixed k, z and k'.

4.2 Aggregation

Let $\mu(k, b, z)$ be the mass of incumbent firms with state variables (k, b, z). μ is the state variable of the aggregate economy and describe the incumbent firms. Let M be the mass of new entrants.

At the end of the current period, both the incumbents and new entrants make the stay/exit decision. So next period, we'll have a new distribution. Let μ' be the next period's distribution of firms. In the stationary equilibrium, $\mu' = \mu = \mu*$ characterizes the distribution of firms. For any set $\Theta = (k, b, z)$, the transition is as follows:

$$\mu'(\Theta) = \int T(\Theta, (k, b, z))d\mu(k, b, z) + M \int X(K, B)G(dz)dQ(z, z') \tag{22}$$

where

$$T(\Theta, (k, b, z) = \int X(K, B)x(k, z; w)dQ(z, z') \tag{23}$$

and

$$X(K, B) = \begin{cases} 1 & \text{if } k(k, b, z; w) \in K \text{ and } b(k, b, z; w) \in B \\ 0 & \text{otherwise} \end{cases} \tag{24}$$

With the stationary distribution μ^*, we can define the aggregate variables of the economy.

$$Y(\mu^*, M; w) = \int (y(k, b, z; w) - f)\mu^*(dk, db, dz) - Mf \tag{25}$$

Notice that the entrants do not produce in the period of entry. Labor demand:

$$L(\mu^*, M; w) \quad = \int l(k, z; w)\mu^*(dk, db, dz) \tag{26}$$

Aggregate capital:

$$K(\mu^*, M; w) \quad = \quad \int k(k, b, z; w)\mu^*(dk, db, dz) + M \int k(0, 0, z; w)G(dz) \tag{27}$$

Aggregate debt:

$$B(\mu^*, M; w) \quad = \quad \int b(k, b, z)\mu^*(dk, db, dz) + M \int b(0, 0, z; w)G(dz) \tag{28}$$

Aggregate Investment is given by:

$$I(\mu^*, M; w) \quad = \quad \int i(k, b, z)\mu^*(dk, db, dz) + M \int i(0, 0, z; w)G(dz) \tag{29}$$

where

$$i(k,b,z) \quad = \quad k(k,b,z) - (1-\delta)k \tag{30}$$

Aggregate profit:

$$\Pi(\mu^*, M; w) \quad = \quad \int pi(k,z;w)\mu^*(dk,db,dz) - M(f_e + f) \tag{31}$$

Aggregate dividend: From this we can define aggregate cash flow or dividend that is paid to the household as:

$$D(\mu^*, M; w) \quad = \quad \int d(k,z;w)\mu^*(dk,db,dz) \tag{32}$$

where $d(k,b,z)$ is the dividend policy.

It is easy to see that all aggregate quantities are jointly homogeneous of degree one in $\mu*$ and M.

4.3 The Household problem

Under the stationary equilibrium, the household solves the following static problem:

$$\begin{aligned} & \max_{c_t} \sum_{t=0}^{\infty} \beta^t log(c_t) \\ s.t. \qquad & c_t = w_t + D_t \end{aligned}$$

This problem yields 1 decisions rule $c(w, D(\mu*, M; w))$

4.4 Stationary Competitive Equilibrium

Definition: A stationary competitive equilibrium is a wage w^*, a mass of entrants M^*, a distribution of firms μ^*, an allocation rule $C(w, \Lambda(\mu, M; w))$ for the household, decision rules $k(k,b,z;w), b(k,b,z;w)$ and a value function $v(k,b,z;w)$ for each firm , aggregate quantities $I(\mu^*, M^*; w^*), L(\mu^*, M^*; w^*)$, $D(\mu^*, M^*; w^*)$, $Y(\mu^*, M^*; w^*), \Pi(\mu^*, M^*; w^*)$, $\Lambda(\mu, M; w)$

such that: (i) the household allocation rule solve the house decision problem

(ii) the firm decision rules and value function solve the firm's problem

(iii) the free entry condition 21 holds (iv) the market clearing conditions are satisfied (v) the consistency conditions are satisfied and $\mu^{*'} = \mu^*$

Markets Clearing Conditions:

$$C(w, \Lambda(\mu^*, M; w)) = Y(\mu^*, M; w) - Mf_e - I(\mu^*, M^*; w^*) \tag{33}$$

$$L(\mu^*, M) = \int l(k, b, z; w)\mu(dk, db, dz) = 1 \tag{34}$$

5 Calibration

In this section we choose the parameter values to quantify the model. Given that our model is similar to some models in the literature, these parameters have been already estimated. For the household problem, the only parameter needed is the discount factor. We use the standard value of 0.96. For the technology process, we use the factor shares and shock process parameters estimated from COMPUSTAT data for the US by Gourio and Miao (2010). Capital share is set $\alpha_K = 0.311$, labor share $\alpha_L = 0.65$, the autoregressive parameter of the shock $\rho = 0.767$ and the standard deviation is $\sigma = 0.211$. These parameters are very similar to those used by Gomes (2001) and Hennessy and Whited (2005).

We also need to calibrate the fixed production cost. This cost will drive fir exit in the case of low realizations of the shock. This parameter is set to match exit rate in the US. Similarly, the entry cost will determine the entry rate and we calibrate this parameter to match entry for the US economy. Later this parameter will be varied to assess the implications of the model.

The interest rate on savings and borrowing need to be calibrated. In the US, the average real risk-free interest rate is around 2.5%. For the wedge between the lending rate and the borrowing rate, we use the value 0.5% as suggested by Livdan et al. (2009).

There are several steps in the computation of the general equilibrium model. Here, we focus on stationary equilibrium with entry and exit. First, for a given wage, we compute the policy functions of the firm. We use value function iteration despite the curse of dimensionality. We iterate on the wage such that the free entry condition 21 to find the optimal wage. We then find the stationary distribution of firms. To find the mass of entrants, we use the labor market clearing condition.

Before computing the general equilibrium, we conduct a partial equilibrium analysis and show the properties of the policy functions of the firm. Figure 4 shows the plot for capital and debt policy functions along with the firm value function. We can see that for a given debt level, the choice of next period's capital is increasing in current's period capital while the choice of next period's debt is hump-shaped. When current capital is fixed, capital policy is decreasing in debt level while the debt policy is increasing. We can see that the value function is increasing in capital and decreasing in debt.

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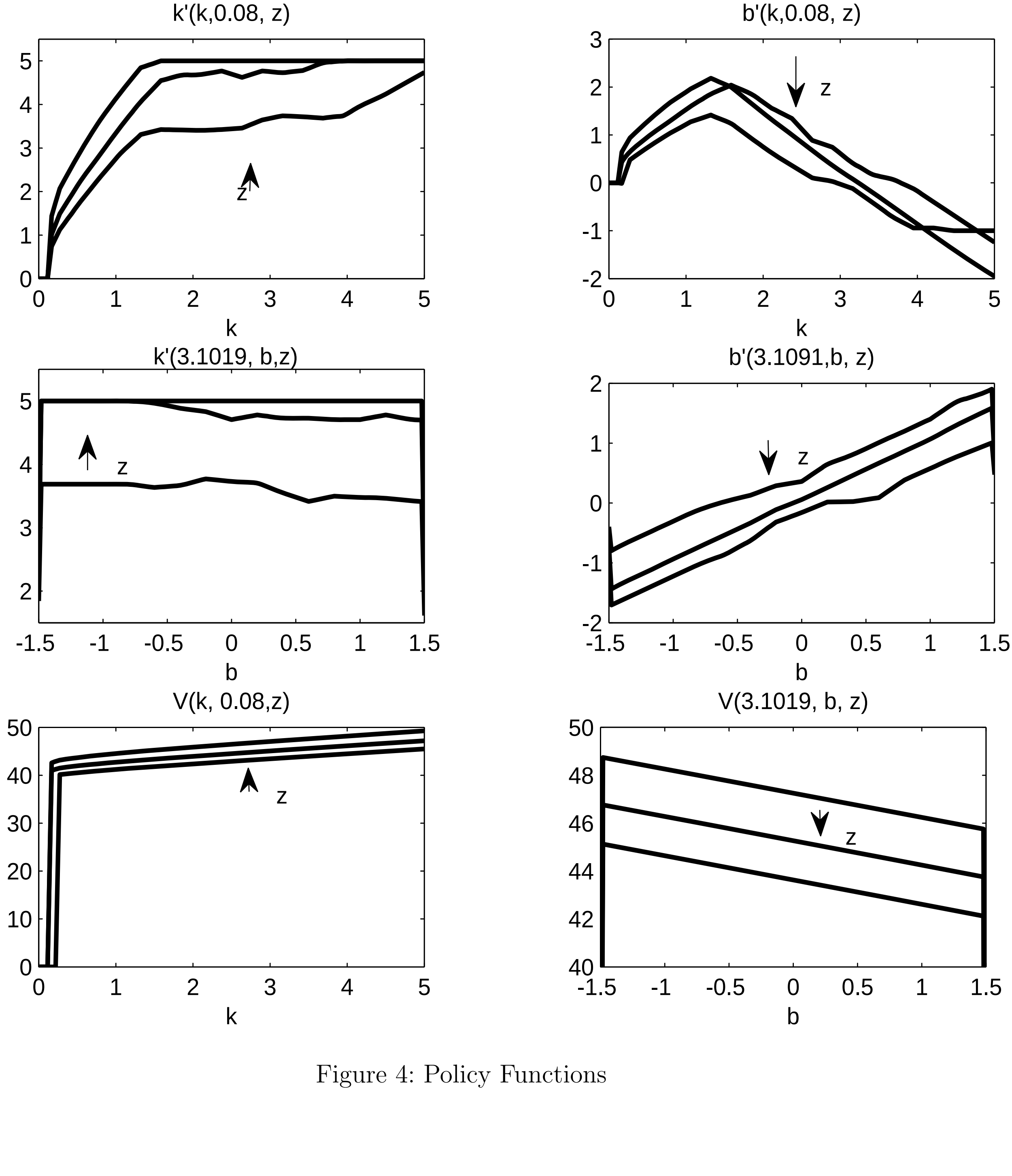

Figure 4: Policy Functions

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