# Entrepreneurship and Endogenous Volatility*

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Very Preliminary and Incomplete

**Abstract**

In this paper we document the relationship between idiosyncratic risk and non productive expenditures at the firm level from the Kauffman Firm Survey. We then propose a model of entrepreneurial activity subject to financial constraints where firms engage in borrowing to finance capital and wages, but also non productive expenses such as brand development, R&D, management consulting, marketing, etc. We allow for the non productive expenditures to affect the spread of the distribution from which shocks are drawn.

*Keywords*: Endogenous idiosyncratic risk, financial frictions, entrepreneurs

*JEL Classifications*: D31, E4, L11, L26 O16

*Certain data included herein are derived from the Kauffman Firm Survey release 4.0. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Ewing Marion Kauffman Foundation.

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# 1 Introduction

Evidence shows that business startups and young firms are inherently different than more mature firms. In this paper, we develop a quantitative model of entrepreneurial activity with capital market imperfections to account for firm size and age dynamics. More specifically, we want to understand the determinants of the cross-sectoral variation in idiosyncratic risk at the firm level. The mechanism we uncover links risk and intangible expenses (or expenses other than those directly related to payments to the factors of production).

The data presented in Haltiwanger et al (2010) points towards a clear role of age in firm dynamics. Suggesting that the time dimension plays a role affecting the firm's performance. In particular they find that, once they control for firm's age, there is no systematic relationship between firm size and growth. The dynamics at the early stages of the firm seem to be extremely volatile, showing what the authors call "up or out" behavior. Conditional on survival, young firms grow more rapidly than their more mature counterparts. However, young firms have a much higher likelihood of exit, are more volatile and exhibit higher rates of gross job creation and destruction.

Other studies also find high levels of volatility at the firm level. Castro, Clementi and Lee (2010) measure the idiosyncratic risk at the firm level for the US manufacturing sector in ways followed by this paper. They find that idiosyncratic risk represents most of the risk faced by the firm, but also that it varies greatly in the cross section. This paper will endogeneize part of the risk through expenses that are not linked to production and that cannot be used as collateral. This mechanism links the financial frictions to which entrepreneurs are exposed to risk and volatility at the firm level.

Among the factors that affect entrepreneurial activity, a recent literature has emphasized the role of capital market imperfections. In this paper, we interpret the age effect as a representation of the relation between organizational capital, investment and financial frictions. By modeling the the decision to open a firm (i.e. become an entrepreneur) we endogeneize the productivity distribution of start up firms. Moreover, we let the evolution of firm productivity to be influenced by intangible expenditures. Instead of being the mere passage of time, we allow the firm to actively learn by spending resources that affect the level of dispersion of its productivity. This idea is connected to the work done by Bloom et. al. (2010) that experimented with a set of indian firms by randomly assigning them management consulting services. They found that these services affected productivity and profitability in a significant way. In our view, that means that once the firms were given this intangible capital (valued at $ 500,000), it affected the evolution of the firm. Our story goes beyond and sheds light on the reasons why these firms did not invest in this intangible capital in the first place.

The paper is organized as follows: In section 2 we present facts linking risk and volatility at the firm level to intangible expenditures from the Kauffman Firm Survey. Sections 3 and 4 introduce an endogenous entrepreneurial activity model where firms (or entrepreneurs) endogenously affect the total factor productivity at the firm level by directing resources outside the direct costs of production. Section 5 presents preliminary results from the model, and section 6 concludes

# 2 Facts: Idiosyncratic Volatility

We are interested in understanding the determinants of cross-sectoral variation in firm-level idiosyncratic risk for newly created firms and its relation with expenses such as brand development, organizational development worker training and other expenses that do not correspond to standard factor input payments such as capital or labor. We use the Kauffman Firm Survey (KFS), a large panel of business founded in 2004 that have been tracked annually and will continue to be tracked through 2011.[1] This panel was created using a random sample from Dun and Bradstreet's database list of new business. The target population was all new business that were started in the 2004 calendar year in the United States and excludes any branch or subsidiary owned by an existing business or a business inherited from someone else. The sample

[1] Current available data expands through year 2008. See http://www.kauffman.org/kfs/ for a detailed description of the data and the public-use microdata itself.

for the first survey consisted of 4,928 business.

This data set provides us the unique opportunity to study a panel of new business from startup with available data on their revenues and expenses, the number of workers and their activity within the firm, how business are financed, the products, services and innovations these business possess and develop in their early years of existence as well as the extent to which these business are involved in innovative activities. Other data sets such as the Panel Study of Entrepreneurial Dynamics and Census data also have information on new businesses. We focus on the KFS because it is particularly suited for answering questions related to the financial status of new firms but also because it has unique information on firm level expenses that do not correspond to factor input payments. One drawback of the KFS publicly available data is that some variables such as assets (and its components) and sales are only reported in given ranges.[2] We recognize that this creates some measurement problems and will try to address them in the future. As a first pass to the data, we set the value of the corresponding variables to the middle value of the reported range.[3] All variables are deflated using CPI. Our unit of observation is the firm as defined by the KFS. Table 1 presents the distribution of sales, expenses and assets for newly born firms (i.e. the distribution of firms in year 2004) and for firms that survive until the end of our sample (year 2008).

[2]For example, ranges for revenues are 0, $1-1000, $1001-5000, $5001-10000, $10001-25000, $25001-100000, $100000 or more.

[3]The set of variables we use that present this problem are revenue from sales of goods, services or intellectual properties, expenses, wages and assets (and its components).

Table 1: Distribution of Sales, Expenses and Assets (active firms, in %)

| | Year 2004 | | | Year 2008 | | |
|---|---|---|---|---|---|---|
| | Sales | Expenses | Assets | Sales | Expenses | Assets |
| Zero | 35.94 | 7.28 | 12.15 | 19.75 | 4.69 | 6.73 |
| $ 1-500 | 2.76 | 4.72 | 2.97 | 1.39 | 3.8 | 2.61 |
| $ 501-1000 | 1.88 | 3.81 | 2.99 | 1.07 | 2.27 | 2.34 |
| $ 1001-3000 | 4.66 | 8.78 | 7.63 | 3.24 | 5.46 | 6.3 |
| $ 3001-5000 | 3.08 | 7.53 | 5.8 | 2.29 | 4.34 | 4.3 |
| $ 5001-10000 | 6.14 | 10.85 | 9.38 | 4.75 | 6.88 | 6.8 |
| $ 10001-25000 | 9.34 | 15.38 | 15.32 | 7.17 | 11.11 | 12.95 |
| $ 25001-100000 | 18.31 | 24.48 | 23.01 | 17.86 | 22.48 | 23.44 |
| $ 100001 or more | 17.89 | 17.17 | 20.75 | 42.48 | 38.97 | 34.51 |
| N Obs. | 4741 | 4726 | 4915 | 2441 | 2602 | 2602 |

Note: Data from KFS. Variables are deflated using CPI.

We observe that many firms are relatively small having sales, expenses and assets below $5000 and this is true even after four years of existence. However, a non trivial number of new firms have sales, expenses and assets above $100000. The distributions clearly shift upwards as the cohort of firms gets older, grow and selection takes place.

Table 2 presents the distribution of newly created firms in the KFS, a comparison with new firms using Census data and also the distribution of firms over employment for our cohort of firms in year 2008.[4]

Table 2: Distribution of workers (active firms, in %)

| Number of Employees | KFS (2004) | Census (2004) | KFS (2008) |
|---|---|---|---|
| 1−4 | 74.4 | 76.7 | 64.8 |
| 5−9 | 15.3 | 13.0 | 17.8 |
| 10−19 | 6.6 | 6.0 | 9.5 |
| 20−99 | 3.4 | 3.8 | 2.9 |
| 100−499 | 0.3 | 0.4 | 5.0 |
| 500 + | 0.0 | 0.0 | 0.0 |

Note: KFS refers to Kauffman Fundation Survey. Census corresponds to Office of Advocacy, Small Business
Administration, Statistics of U.S. Business, U.S. Census 2004.

[4]For comparison, we use report the distribution conditional on firms having more than one worker. In the KFS, we find that 58% of active firms hire zero workers and this value equals 44% in 2008.

Table 2 shows that a large fraction of firms is created with only few workers. More than 70% of new firms hire one and four workers. As a comparison, we present the distribution of new firms using Census data and we note that the distributions are very similar. This reassure us that we have a representative sample of new firms despite some differences in the industry distribution of new firms and the different methodologies used across sources. Finally, and consistent with the evidence presented in Table 1, we observe that there is a sizable reduction in the fraction of firms with less than 4 workers as well as an increase in the fraction of firms with more than 10 workers when looking at the distribution of active firms in the KFS in 2008.

Table 3 displays the distribution of firms for some representative industries and its one year survival rate.

Table 3: Distribution of firms over industries and survival rates

| Industry | Fraction of Firms (%) | One Year Survival Rate (%) |
|---|---|---|
| Construction | 10.0 | 91.9 |
| Manufacturing | 7.1 | 92.0 |
| Wholesale | 5.4 | 88.7 |
| Retail | 15.9 | 86.1 |
| Transportation and Warehousing | 3.4 | 84.7 |
| Information | 2.7 | 84.6 |
| Finance and Insurance | 4.7 | 95.8 |
| Administration and Support | 9.6 | 91.7 |
| Accommodation and Food Services | 4.3 | 77.7 |

Source: Kauffman Fundation Survey.

We now turn to the analysis of firm level productivity. Following Castro, Clementi and Lee (2010) among others, we proxy idiosyncratic risk with the portion of the variation in firm's growth in sales or TFPR that is not accounted for by aggregate disturbances or by other factors that vary systematically with growth such as size (assets in our data).[5] The first step to obtain

[5]Age is generally used as a factor, but since we are focusing in firms that started in 2004 the age effect is already factored in.

our measure of idiosyncratic volatility is to estimate the following equation:

$$\Delta \ln(sales)_{ijt} = \mu_i + \delta_{jt} + \beta_{1j} \ln(size)_{ijt} + \epsilon_{ijt}, \tag{1}$$

where $\Delta \ln(sales)_{ijt}$ is the growth of real sales for firm $i$, in industry $j$ in period $t$.[6] The variable $\mu_i$ is a firm fixed effect that accounts for unobserved persistent heterogeneity at the firm level (such as higher productivity, higher human capital of the entrepreneur, etc). The variable $\delta_{jt}$ denotes a full set of time-industry specific shocks.[7] We allow for industry specific size effects. The estimation of equation (1) is done using the fixed effects panel estimator with robust standard errors.

An alternative to equation (1), it is to obtain the idiosyncratic random component at the firm level from changes in log-TFPR (firm total factor productivity) derived from

$$\ln(TFPR)_{ijt} = \ln y_{ijt} - \alpha^k \ln k_{ijt} - \alpha^n \ln n_{ijt}, \tag{2}$$

where $y_{ijt}$ denotes total real revenues, $k_{ijt}$ is capital and $n_{ijt}$ corresponds to total workers for firm $i$, in industry $j$ in period $t$. Total workers refers to total workers in production, sales and general administration. Capital is constructed by adding the total value of equipments and machinery, land and buildings, vehicles and inventories. Factor shares are set to $\alpha^k = 0.90 \times (1/3)$ and $\alpha^n = 0.90 \times (2/3)$ a standard value in the firm dynamics literature. Then, with some abuse of notation, to obtain the pure idiosyncratic component we also estimate the following equation:

$$\Delta \ln(TFPR)_{ijt} = \mu_i + \delta_{jt} + \beta_{1j} \ln(size)_{ijt} + \epsilon_{ijt}, \tag{3}$$

where $\Delta \ln(TFPR)_{ijt}$ is the growth of total factor productivity for firm $i$, in industry $j$ in period $t$. As in the previous case, the estimation of equation (3) is done using the fixed effects panel estimator with robust standard errors.

[6]We use revenues from sales of goods, services or intellectual properties as our measure of sales. Firm-year observations with sales reported to be equal to zero are not used in the estimation of equation (1).

[7]We have two digits NAICS codes for firms in our sample.

Once parameters in equation (1) or (3) are estimated, we can compute $\hat{\epsilon}_{ijt}$, the pure idiosyncratic and unpredictable component of firm growth (i.e. the firm specific shocks). Given $\epsilon_{ijt}$ we can study how its standard deviation is related to expenses on brand development, organizational development or organization development once industry specific factors are accounted for. In particular, we estimate the following log-linear equation

$$\ln(\epsilon^2)_{ijt} = \theta_j + \alpha_1 \ln(expense)_{ijt-1} + u_{ijt}, \tag{4}$$

where $\theta_j$ is the industry specific component and $\ln(expense)_{ijt-1}$ corresponds to the lag measure of expenses for firm $i$ in sector $j$. The variable expenses is constructed as total expenses minus wage payments to workers in production, sales and general administration, i.e. expenses that do not correspond to inputs of production. In order to do this, we first construct an average wage at the firm level ($w_{ijt}$) as the ratio of total wages to total workers. We then multiply $w_{ijt}$ by the number of workers in production, sales and general administration to find a value for payments to production inputs. We subtract input payments from total expenses to derive our measure of expenses.[8]

Table 4 present the estimates from equation (4) with industry controls and without and for measures derived from sales growth (equation (1)) and from growth of TFPR (equation (3)).

Table 4: Firm level idiosyncratic volatility

| | Dependent Variable | | | |
|---|---|---|---|---|
| Regressors | $\ln(\epsilon^2)$ from eq. (1) | $\ln(\epsilon^2)$ from eq. (1) | $\ln(\epsilon^2)$ from eq. (3) | $\ln(\epsilon^2)$ from eq. (3) |
| log($expense$) | -0.067 | -0.0528 | -0.109 | -0.056 |
| Std Error | 0.026** | 0.019*** | 0.047** | 0.034* |
| Industry Controls | No | Yes | No | Yes |
| N obs | 2694 | 2694 | 1769 | 1769 |
| R-squared | 0.003 | 0.120 | 0.007 | 0.607 |

Note: *** denotes significant at the 1% level, ** at the 5% level and * at the 10% level. Robust Standard Errors reported.

[8] Total expenses refers to total expenses paid by the firm and include costs paid for the operation of the business such as wages and salaries, interest on loans, capital leases, materials, etc.

Under both specifications we find a significant relation between firm level idiosyncratic volatility and expenses (even after controlling for industry fixed effects). The elasticity of volatility with respect to expenses is approximately lies between -0.05 to -0.11. This implies that a one percent change in expenses implies a reduction in volatility between 0.05 and 0.15 percent. In our sample, the average change in expenses is about 20%, that means that the average firm obtains a reduction in volatility approximately between 1 and 2 percent. These results are robust to different specifications that capture expenses other than factor input payments such as the contemporaneous measure of expenses we constructed, an indicator for expenses on research and development and and indicator for expenses incurred in brand development, organizational development or worker training.

In what follows, we will explore the relation between volatility and expenses in more detail through the lenses of our model.

# 3 Environment

We built a model of entrepreneurial activity with financial frictions. The period is set to one year. Time is discrete. The economy is populated by a continuum of infinitely lived ex-ante identical agents of total measure normalized to 1. At any point in time, agents choose between being workers or entrepreneurs. Entrepreneurs are identified with those that own a business and play an active management role. We will look for a stationary competitive equilibrium. The economy is modeled as a small open economy in which the risk free rate $r$ is given exogenously.

## 3.1 Preferences

Agents maximize expected life time utility

$$U \equiv E_0 \sum_{t=0}^{\infty} \beta^t u(c_t),$$

where $\beta$ is the discount rate, $u(c_t)$ is a continuous and strictly concave utility function that depends on consumption $c_t$.

Agents are endowed with one unit of time. They can supply this unit of time to the market at wage $w$ or use it for managerial activities in their own business. The household also has the opportunity of running a business, i.e. becoming an entrepreneur.

## 3.2 Technology

The production technology is given by

$$y = f(\epsilon, k, n) = \epsilon k^{\alpha} n^{\gamma}, \tag{5}$$

where $y$ is gross output, $\epsilon$ is entrepreneurial ability, $k$ is capital and $n$ is labor. We assume that $\alpha + \gamma < 1$. Individuals are born with entrepreneurial ability $\epsilon$. If the agent chooses not to operate the technology (i.e. periods when the agent is a worker), $\epsilon$ evolves according to $\omega(\epsilon'|\epsilon)$. If the household operates the technology, $\epsilon$ evolves according to $\zeta(\epsilon'|\epsilon, x)$ where $x$ denotes the amounts of intangible expenditures incurred by the entrepreneur in the current period. We assume that intangible expenditures affect the evolution of $\epsilon$ by changing the dispersion of its future values. More specifically, we assume that $\text{Var}(\epsilon'|\epsilon, x^0) \geq \text{Var}(\epsilon'|\epsilon, x^1)$ for $x^1 \geq x^0 \geq 0$.

The intangible capital's role is to reduce the volatility of the productivity / entrepreneurial / demand shock. We interpret it as resources that are devoted to learning aspects related to their environment and therefore, reduce the volatility of their productivity process. We understand part of the productivity volatility to be controllable by the managers of the firms if they engage in process improvements, market research, etc. On top of the market, product and process research and development that the entrepreneur can spend resources in, they have to pay an entry costs in order to operate their technology (or entrepreneurial ability), which is a one time costs per firm these entrepreneurs open.

### 3.3 Asset Markets

There is a competitive financial system. Financial intermediaries have access to the risk free return $r$.

Households that choose to be workers can accumulate financial assets $a \geq 0$. Entrepreneurs can accumulate assets but they are also allowed to borrow at price $q(\cdot)$. Entrepreneurs can go bankrupt and default on their debt. After default, lenders will seize all the available capital (net of bankruptcy costs $\phi$) up to a fraction $\lambda$ of the original debt. In case of default, the entrepreneurial ability evolves according to $\xi(\epsilon'|\epsilon)$ and net worth of entrepreneurs becomes zero. Default is assumed to take only one period, when the entrepreneur is involved in liquidating the firm while working at the market wage (the entrepreneur receives the ungarnished wages during the period of default, given by $(1-\tau)$). No other penalties are assumed.

Entrepreneurs are assumed to be the only agents in the economy with the ability to invest outside the financial system (in physical and intangible capital). They accumulate capital $k$ that will be used for production.

Because there is perfect competition, financial intermediaries will make zero profits in each contract. This implies that there is no cross-subsidization of interest rates across different types of borrowers. In this environment will full information, the price of debt will reflect the endogenous repayment probability and the recovery rate in case of default. The return on savings will be equal to the exogenous risk free rate $r$.

# 4 Equilibrium

### 4.1 Incumbent entrepreneur

Given their realization of the productivity shock $\epsilon$, and their physical capital $k$ and net financial assets $a$ they make the default decision and later on they invest, save/borrow, rent labor and make intangible expenditures $x$. In other words, they solve the following dynamic problem:

$$V^e(k, a, \epsilon) = \max\left\{V^d(k, a, \epsilon), V^o(k, a, \epsilon)\right\}$$

where $V^d(k, a, \epsilon)$ is the value of default, $V^o(k, a, \epsilon)$ is the value of continuing operations as a firm.

The value of continuing operations is given by

$$V^o(k, a, \epsilon) = \max_{k', a', n, x} u(c) + \beta \int v(k', a', \epsilon') d\zeta(\epsilon'|\epsilon, x)$$

subject to

$$c = \pi(\epsilon, k) - q(k', a', \epsilon, x)a' + a + (1 - \delta)k - k'$$

$$\pi(\epsilon, k) = \epsilon k^{\alpha} n^{\gamma} - wn - x - c_f$$

$$\{k', x, n\} \geq \{0, 0, 0\}$$

where $v(k, a, \epsilon)$ is the value at the beginning of the period to be described below.

The value of default is given by

$$V^d(k, a, \epsilon) = u(w(1 - \tau) + \max\{0, (1 - \phi)k + \lambda a\}) + \beta \int v(0, 0, \epsilon') d\chi(\epsilon'|\epsilon),$$

The solution to this problem provides a default decision rule $d(k, a, \epsilon)$, a capital accumulation rule $k'(k, a, \epsilon)$, an asset accumulation rule $a'(k, a, \epsilon)$, labor demand $n = (k, a, \epsilon)$, intangible investment rule $x(k, a, \epsilon)$ as well as the value functions.

## 4.2 Workers

Given that we restrict the worker to have positive net worth, the value of being a worker is given by,

$$V^w(a, \epsilon) = \max_{a' \geq 0} u(w - a'(1 + r)^{-1} + a) + \beta \int v(0, a', \epsilon) d\omega(\epsilon'|\epsilon)$$

The solution to this problem provides an asset accumulation rule $a'(a, \epsilon)$ and the worker value function.

## 4.3 Worker / Entrepreneur decision

At the beginning of each period, agents (both workers and entrepreneurs) can choose to become a worker or an entrepreneur as follows:

$$v(k,a,\epsilon)=\begin{cases}\max\{V^e(k,a,\epsilon),V^w(k+a,\epsilon)\} & \text{if } (k+a)\geq 0;\\ V^e(k,a,\epsilon) & \text{if } (k+a)<0.\end{cases}$$

We are assuming that workers can only hold positive net financial assets. An entrepreneur that wants to transit to worker can do so in two ways. First, he/she can default and effectively clean out its debt and by doing so will start the following period with zero net worth. Or, he/she can sell his capital, pay the debt, effectively closing the firm and transforming anything left into net financial assets.

The solution to this problem provides the occupational choice $g(k,a,\epsilon)\in\{w,e\}$.

## 4.4 Financial intermediaries

Given the schedule of interest rates, profits in a contract that specifies a borrowing level $a'$ for an entrepreneur choosing future capital $k'$, intangible investment $x$ and that has entrepreneurial ability $\epsilon$ are:

- if $a'<0$

  $$\pi(k',a',\epsilon,x)=q(k',a',\epsilon,x)a'-\frac{1-p(k',a',\epsilon,x)}{1+r}a'-\frac{p(k',a',\epsilon,x)}{1+r}\min\left\{\lambda a',-(1-\phi)k'\right\},$$

  Where $p(k',a',\epsilon,x)$ is the default probability per financial contract and $r$ is the risk free interest rate.

- if $a'\geq 0$

  $$\pi(k',a',\epsilon,x)=q(k',a',\epsilon,x)a'-\frac{a'}{1+r}.$$

Perfect competition implies that borrowing prices $q(k', a', \epsilon)$ in each contract is such that profits are zero.

### 4.5 Definition of Equilibrium

A stationary competitive equilibrium is a set of value functions $v(k, a, \epsilon)$, decision rules (capital, net asset position, default, entrepreneurial activity, expenditures in intangibles), a wage rate $w$, aggregate distributions of firms $\vartheta(k, a, \epsilon)$ and workers $\overline{\vartheta}(a, \epsilon)$ such that:

- Given prices, the value functions of firms and workers are consistent with both agents optimizing.
- Lenders make zero profit for every type of loan.
- Invariant distributions $\vartheta$ and $\overline{\vartheta}$ are stationary.
- The labor market clears.

## 5 Calibration - Preliminary

Other than the usual parameters (time preference, depreciation rate and production function) the following key parameters need to be calibrated to generate meaningful dynamics.

- Transition matrices $\zeta(\epsilon'|\epsilon, x)$, $\chi(\epsilon'|\epsilon)$, $\omega(\epsilon'|\epsilon)$, while a firm (function of expenditures $x$), upon default and while a worker respectively. In particular we set the transition functions so that the following is true:

  $$\epsilon' = (1 - \rho)\mu + \rho\epsilon + \nu'$$

  Where $\nu$ is distributed $N(0, \sigma(x))$ and the function $\sigma(x)$ is given by

  $$\sigma(x) = (1/(1 + x))^{\theta}(\overline{\sigma} - \underline{\sigma}) + \underline{\sigma}$$

In the case of $\chi(\epsilon'|\epsilon)$ and $\omega(\epsilon'|\epsilon)$ we take the maximum value of the volatility of $\sigma(x)$ and impose the normal distribution with no persistence while a worker or upon default. The parameters governing the relationship between volatility and expenditures are the following:

  - $\theta = 1.5$
  - $\overline{\sigma} = 0.3$
  - $\underline{\sigma} = 0.05$

- Unconditional distribution of entrepreneurial ability $\omega()$
- Wage garnishment fraction $\tau = 0.8$
- Capital share and labor share, $\alpha = 0.27$ and $\gamma = 0.64$
- Depreciation rate $\delta = 0.08$
- Time discount factor $\beta = 0.9$
- Risk free interest rate $r = 0.05$
- $u(c) = log(c)$
- Fix cost of operation $c_f$ of 0.25
- Average productivity, determining average size of firm, $\mu = 0.25$
- Productivity persistence $\rho = 0.885$
- Recovery rate $\lambda = 0.77$ and cost of default proceedings $\phi = 0.07$ as reported by the World Bank on Doing Business for the US.

# 6 Model Outcome

With the parameters from the previous section we closed the model. That means that we obtained each financial contract price to reflect its own default probability and the wage rate that equates the supply and demand of workers (the supply coming from firms managed by entrepreneurs and the demand coming from the population not engaged in managing firms). The results are as follows:

Table 5: Model Outcome

| | |
|---|---|
| Wage rate | 0.42 |
| Average Volatility | 0.291 |
| | |
| Volatility Distribution | |
| $\sigma = 0.075$ | 1.35 |
| $\sigma = 0.225$ | 3.18 |
| $\sigma = 0.150$ | 0.86 |
| $\sigma = 0.300$ | 94.6 |
| | |
| Default Rate | 7.76 |
| | |
| Size Distribution - Employees | |
| 1 to 4 | 57.44 |
| 5 to 9 | 7.79 |
| 10 to 20 | 11.98 |
| 20 to 99 | 11.08 |
| 100 to 499 | 9.98 |
| More than 500 | 1.72 |
| | |
| Average size | 48.52 |
| Average age | 7.96 |
| Fraction of Entrepreneurs | 1.89 |

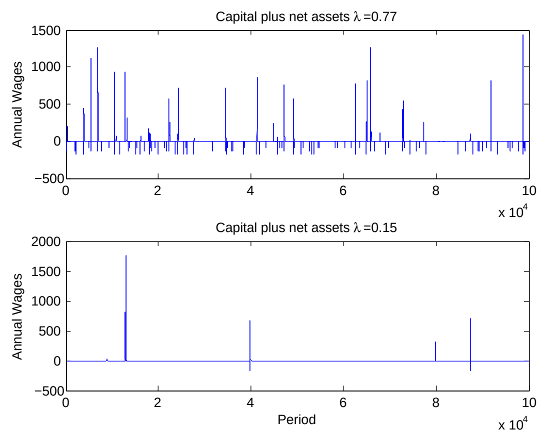
# 7 Effects of financial frictions

In order to analyze the effects of the financial friction we change the recovery rate parameter from 77% to 15% (which is the median recovery rate for the low income countries as reported by the World Bank in the Doing Business Database). The results are as follows:

Table 6: Effects of Financial Frictions

| | $\lambda = 0.77$ | $\lambda = 0.15$ |
|---|---|---|
| Wage rate | 0.42 | 0.34 |
| Average Volatility | 0.291 | 0.2907 |
| | | |
| Volatility Distribution | | |
| $\sigma = 0.075$ | 1.35 | 1.62 |
| $\sigma = 0.225$ | 3.18 | 2.16 |
| $\sigma = 0.150$ | 0.86 | 1.8 |
| $\sigma = 0.300$ | 94.6 | 94.42 |
| | | |
| Default Rate | 7.76 | 3.06 |
| | | |
| Size Distribution - Employees | | |
| 1 to 4 | 57.44 | 38.41 |
| 5 to 9 | 7.79 | 18.3 |
| 10 to 20 | 11.98 | 11.59 |
| 20 to 99 | 11.08 | 15.41 |
| 100 to 499 | 9.98 | 11.05 |
| More than 500 | 1.72 | 5.25 |
| | | |
| Average size | 48.52 | 77.8 |
| Average age | 7.96 | 10.83 |
| Fraction of Entrepreneurs | 1.89 | 0.56 |

The effects of the financial friction are also evident when we simulate the model. In this case we simulate the model for 10,000 periods for an individual that starts as a worker without assets or capital and follow the individual's net worth.




# 8 Conclusion

To be written...

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