# Risky Business: The Choice of Entrepreneurial Risk under Incomplete Markets

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**Abstract**

This paper studies how uninsurable entrepreneurial risk reduces entrepreneurial activity and affects aggregate output, productivity, and the distribution of wealth. I model how individuals decide to become entrepreneurs and to start different types of risky businesses. Using micro data on U.S. firms, I discipline the strength of two financial frictions, a missing market for entrepreneurial risk and borrowing constraints. Completing the missing market for entrepreneurial risk improves aggregate output by 7.7%, which is more than twice the 2.9% increase that results from relaxing the borrowing constraints. I also study a government-backed insurance scheme for unsuccessful entrepreneurs that increases aggregate output.

**Keywords:** Entrepreneurship, Risk-Taking, Financial Frictions, Aggregate Productivity, Wealth Inequality

**JEL Codes:** E20, D31, G32, J24, L26

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# 1 Introduction

Entrepreneurship is a risky endeavour. The majority of new businesses exit within the first few years (Decker et al., 2014) and even conditional on surviving, entrepreneurial earnings are much more volatile than labour earnings (DeBacker et al., 2023). Entrepreneurs typically can not directly insure against the risk that their business fails because of standard moral hazard and adverse selection problems. This inability to insure can discourage the creation of new businesses, distort the type of businesses that do get started, and reduce the amount of investment in productive capital. Given that entrepreneurs running privately held firms employ 69% of private sector employment (Asker et al., 2015) and constitute 74% of the wealthiest 1% of households[1], this inability to insure can have important aggregate implications.

In this paper, I study the quantitative importance of a missing market for entrepreneurial risk on aggregate output, productivity, and the distribution of wealth. I contrast this missing market with a more commonly studied financial friction, entrepreneurial borrowing constraints, which limit the amount of debt entrepreneurs can raise in order to invest in capital. This paper examines how both of these financial frictions impact aggregate economic outcomes by distorting individuals' decisions to start new businesses, their decisions to pursue riskier or safer business ideas, and their decisions about the level of investment.

This paper makes three main contributions. First, I build a model of entrepreneurship that combines two distinct sources of financial frictions. The first financial friction is a missing market for entrepreneurial risk. Since at least Kihlstrom and Laffont (1979), it has been recognized that uninsurable entrepreneurial risk can discourage the extensive margin of entrepreneurial entry. In addition to this extensive margin, I add an intensive margin of entrepreneurial risk choice. Conditional on choosing to be an entrepreneur, individuals decide between a menu of different types of risky businesses. A missing market for entrepreneurial risk encourages entrepreneurs to choose less-productive businesses if they are also less risky. The second financial friction is entrepreneurial borrowing constraints that limit how much capital entrepreneurs can invest in (Evans and Jovanovic, 1989).

Second, I measure the losses to aggregate productivity and output from the missing market for entrepreneurial risk in the U.S. economy. A large literature[2] has studied how financial frictions distort entrepreneurial decisions and impact aggregate productivity and output. While previous work has focused on entrepreneurial borrowing constraints, I focus on how a missing market for risk can distort entrepreneurial decisions, contrasting its effects with borrowing

[1] 2004 Survey of Consumer Finances. The Kauffman Firm Survey data I study in this paper consists of new businesses started in 2004. To be consistent, I use the 2004 wave of the Survey of Consumer Finances throughout this paper to characterize the distribution of wealth.

[2] See for example Buera (2009), Buera et al. (2011), Moll (2014), and Midrigan and Xu (2014), or the review Buera et al. (2015).

constraints. I find that the missing market for entrepreneurial risk reduces aggregate output by substantially more than entrepreneurial borrowing constraints.

Third, I study how the missing market for entrepreneurial risk contributes to wealth inequality. I build on quantitative work by Cagetti and De Nardi (2006) who show that a model of entrepreneurship with both borrowing constraints and a luxury bequest motive can generate the high concentration of wealth observed in U.S. data. I model uninsurable entrepreneurial risk differently along two dimensions. First, entrepreneurs can choose how risky a business to start, with higher-risk businesses generating higher expected returns. Second, in Cagetti and De Nardi (2006) individuals make occupational decisions after productivity shocks are realized and face no capital liquidation costs. This means that uninsurable entrepreneurial risk has no impact on the occupation choice. By contrast, in my model occupational decisions are made before productivity shocks are realized and capital is illiquid. Both features mean that uninsurable entrepreneurial risk will discourage risk-averse individuals from selecting into entrepreneurship. I find that the missing market for risk is a major contributor to the high concentration of wealth at the top of the distribution.

To study the aggregate effects of these two financial frictions, I build a dynamic equilibrium model of entrepreneurship. Individuals have two types of ability, entrepreneurial and worker. Each period, they choose to be an entrepreneur or a worker. When an individual chooses to become an entrepreneur they also decide how risky a business to start, with higher-risk businesses resulting in higher expected productivity. A missing market for risk prevents individuals from insuring against shocks to their abilities or their businesses' productivity. Entrepreneurs also face borrowing constraints that limit the amount of capital they can invest in. Wealth helps individuals overcome both of these financial frictions, as it allows them to self-insure against the risks they face and self-finance a large capital stock. Consequently, wealth plays an important role in an individual's decision to become an entrepreneur and in their decision of how risky a business to start.

I use micro data from the Kauffman Firm Survey to quantify the importance of the two financial frictions. In the calibrated model, both financial frictions play an important role distorting individual choices. The missing market for risk discourages entrepreneurs from starting high-risk businesses and individuals from becoming entrepreneurs. If entrepreneurs had access to complete insurance markets they could start a business with the highest expected productivity and then fully insure themselves against the resulting risks. Faced with the missing market, some entrepreneurs will choose lower expected productivity businesses because these businesses have a lower probability of failure and generate more certain income. Similarly, some individuals may choose to be workers, even though their expected income as entrepreneurs is higher, because entrepreneurial income is more volatile than workers' income. Wealth helps individuals self-insure against idiosyncratic shocks, as wealthy individuals are able to use their wealth to smooth out their consumption. As a consequence, wealthier individuals are more likely to become entrepreneurs and are more likely to start higher-risk businesses.

Borrowing constraints limit the size of many entrepreneurs' businesses and discourage individuals from becoming entrepreneurs. In the absence of borrowing constraints, a low-wealth individual with high entrepreneurial ability might rent a large stock of capital in order to operate a large scale business. However, borrowing constraints prevent these low-wealth entrepreneurs from renting as much capital as they would like, forcing them to operate inefficiently small businesses. These smaller businesses generate less income for their entrepreneurs. If this reduced entrepreneurial income falls below what they could earn as a worker, some low-wealth individuals will choose to be workers despite their high entrepreneurial ability.

The main quantitative analysis I perform is to remove each financial friction and compare the resulting steady state equilibria. I first complete the missing market for risk by introducing a full set of state-contingent assets. Each individual is able to buy or sell securities at actuarially fair prices based on their individual abilities and their businesses' productivity. I then relax the borrowing constraints, allowing entrepreneurs to invest in any amount of capital regardless of their personal net-worth.

I find that completing the missing market for entrepreneurial risk improves aggregate output by 7.7%. The state-contingent assets allow individuals to transfer resources from the state of the world where their business is successful to the state of the world where their business is unsuccessful. As a direct consequence, all entrepreneurs choose to run businesses with the highest expected productivity and use the state-contingent assets to insure themselves against the resulting risks.

Relaxing entrepreneurial borrowing constraints, so that entrepreneurs are unrestricted in the amount of capital they can invest in, increases aggregate output by 2.9%. Entrepreneurs that were previously constrained to operate inefficiently small businesses are now able to invest in much more capital. Some low-wealth individuals with high entrepreneurial ability switch from being workers to being entrepreneurs. Without the constraint, they can now run larger businesses and therefore generate more income as entrepreneurs. As a consequence of the increased investment, the aggregate capital stock increases by 11.8%. At the same time, higher ability entrepreneurs and less capital misallocation improve aggregate productivity.

Completing the missing market for risk also substantially reduces wealth inequality. The share of wealth held by the top 1% falls from 26% down to 11%. This decline is due to two forces. Firstly, the direct effect of insurance, which mechanically reduces dispersion in outcomes. Secondly, one source of rate-of-return heterogeneity is eliminated by completing the missing market. In the benchmark economy, wealthier entrepreneurs choose to start higher-risk businesses. These high-risk businesses earn higher expected returns on average, leading to faster wealth accumulation by the wealthier entrepreneurs. When all entrepreneurs are able to insure against business risk, they all choose to start the highest expected productivity businesses, removing this difference in the rates of return. This means that completing the missing market for risk leads to a rare equity-efficiency win-win, with both an increase in aggregate productivity and a reduction in wealth inequality.

Finally, I demonstrate that these quantitative results have implications for public policy by showing that a government can increase aggregate output with a simple partial insurance scheme for entrepreneurs. Given the large increases in aggregate output and productivity from completing the missing market, a natural policy implication is for governments to provide more insurance to entrepreneurs. However, any public insurance scheme may run into problems with adverse selection if it encourages low-ability individuals to choose to become entrepreneurs, not because they expect to make substantial income as entrepreneurs, but because the insurance payouts would be larger than the wages they would earn in the labour market. I study a simple insurance scheme where governments can only observe an entrepreneur's income. When this insurance scheme pays out moderate benefits it encourages more entrepreneurs to start higher-risk businesses leading to higher aggregate productivity. Aggregate output increases because few low-ability individuals choose to become entrepreneurs. At higher levels of benefits, adverse selection overwhelms the positive benefits of higher-risk taking and aggregate output decreases.

Section 2 provides evidence on entrepreneurial risk taking and funding sources from the Kauffman Firm Survey that motivates some of the modelling choices in this paper. I present my dynamic model of entrepreneurship in section 3. Section 4 explains how I quantify the strength of the two financial frictions using the micro data. I report the results of the quantitative analysis where I remove the two financial frictions in section 5 and some robustness under different modelling assumption in section 6. Section 7 studies the effects of a simple government policy that provides partial insurance to entrepreneurs. Section 8 concludes.

## Related Literature

This model in this paper is related to a large literature on the decision to become an entrepreneur. In my model individuals decide to become an entrepreneur based on their abilities and two financial frictions. These two financial frictions correspond to two different strands of literature studying the decision to start a business. First, papers such as Kihlstrom and Laffont (1979) and Cressy (2000) argue that uninsurable entrepreneurial risk is a major barrier to becoming an entrepreneur. Second, a literature starting with Evans and Jovanovic (1989) considers how borrowing constraints will influence the decision to become an entrepreneur, see also Quadrini (2000), Gentry and Hubbard (2004), Hurst and Lusardi (2004), and Cagetti and

De Nardi (2006). My paper incorporates both of these mechanisms of occupational selection and quantify their relative importance for aggregate outcomes.

The quantitative analysis in this paper contributes to a large literature studying how financial frictions distort entrepreneurial decisions and the impacts on aggregate productivity and output. My paper studies how the missing market for risk distorts entrepreneurial decisions. Previous work in this area has focused on borrowing constraints. For example, papers such as Buera (2009), Buera et al. (2011), Moll (2014), Midrigan and Xu (2014), and Castro and Sevcik (2016), study how borrowing constraints impact entrepreneurial decisions, including whether to start a business, which sector to start businesses in, whether to adopt more capital-intensive technology, or how much to invest in human capital.

My paper also contributes to a literature studying the determinants of the distribution of wealth. Two surveys of this literature, De Nardi and Fella (2017) and Benhabib and Bisin (2018), consider differences in the earned rates of return to be key drivers of the high concentration of wealth. In my model, entrepreneur's endogenous choice of business risk generates a previously unstudied channel for explaining the high concentration of wealth. Wealthier entrepreneurs choose higher-risk businesses that on average earn them higher returns. This is consistent with empirical evidence from Scandinavian countries. Both Bach et al. (2020) and Fagereng et al. (2020) show that wealthier individuals do in fact earn persistently higher rates of return on their assets. See also Peter (2021), which looks at how ownership institutions across countries lead to different levels of wealth inequality with a model of entrepreneurship.

This paper is closely related to two papers that study entrepreneur's choice of risk. First, Choi (2017) uses U.S. Census Bureau data to provide evidence that individuals who had higher paying jobs prior to starting a business take larger risks, as measured by higher exit rates, more dispersion in growth, and faster average growth conditional on survival. In a quantitative model, he demonstrates the importance of entrepreneur's labour market options for encouraging entrepreneurial risk taking. By contrast, my paper uses a quantitative model to measures the aggregate losses from uninsurable entrepreneurial risk.

Second, Vereshchagina and Hopenhayn (2009) study how wealth impacts both the choice to become an entrepreneur and the choice of business risk. In their model, low-wealth entrepreneurs start riskier businesses due to a non-concavity in the value function created by the insurance value of becoming a worker in the future. I find the opposite result with low-wealth individuals starting safer businesses. The key difference between their model and mine is that in my model higher-risk businesses deliver higher expected productivity while in the Vereshchagina and Hopenhayn (2009) model all businesses have the same expected productivity.

This paper is also related to Tan (2022) which studies how capital illiquidity impacts the risk of entrepreneurs and looks at how risk-sharing mechanisms for illiquidity risk impact the degree of wealth inequality in the economy. Also related is Cole et al. (2016) which studies a model of project selection where projects differ in the concavity-or-convexity of their productivity growth over time. Through a dynamic contracting problem, they show how more effective monitoring leads to different project choices in countries with more developed financial sectors.

Empirical work documenting that entrepreneurs face a high degree of uninsurable idiosyncratic risk motivate the focus in my paper on the missing market for entrepreneurial risk. Entrepreneurship is risky both because of the risk of business failure and the volatile nature of entrepreneurial income. Decker et al. (2014) find that most new businesses exit within the first ten years. DeBacker et al. (2023) and Boar et al. (2022) document the high volatility of entrepreneurial earnings and returns, while Castro et al. (2015) measures the importance of idiosyncratic shocks relative to aggregate shocks.

Finally, this paper is related to a large literature on government policy for entrepreneurs. In particular, this paper's policy analysis complements the empirical results in Hombert et al. (2020), who study a reform in France that extended unemployment insurance to self-employed individuals. They find that the reform led to more new businesses that had higher productivity than incumbents. My paper's key policy implication is that providing unemployment-like insurance to entrepreneurs can increase risk taking and therefore aggregate productivity.

Quantitative work on government policy for entrepreneurs tends to focus on a single financial friction. Meh (2005), Brüggemann (2021), and Guvenen et al. (2023) all study the effects of different government taxes on entrepreneurs given the existence of borrowing constraints. By contrast, Panousi and Reis (2019) considers optimal taxation with uninsurable capital income risk. The quantitative results in my paper suggests that entrepreneurial policies should not ignore either of these frictions, as the missing market for risk and borrowing constraints are both quantitatively important.

# 2 Stylized Facts

## 2.1 Kauffman Firm Survey Data

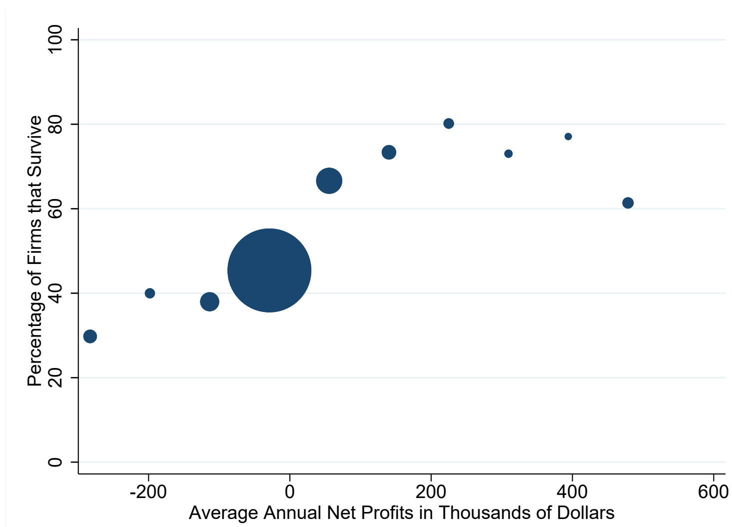
The Kauffman Firm Survey is a representative panel sample of new U.S. firms. All firms are founded in the year 2004, and the survey follows them until they exit or until 2011. It was designed to provide a representative sample of all new businesses started in 2004. The firms include businesses that were independently founded, purchased from an existing business or purchased as a franchise, and exclude any inherited businesses, any non-profits, and businesses that were started as a branch or subsidiary of an existing business. For each firm, information for up to 10 owners is provided.

The Kauffman Firm Survey firms are highly heterogeneous. The majority of firms are non-employers in the first year, though many go on to hire at least one worker later. Most firms are owned and operated by a single entrepreneur, though a small proportion have multiple owners.

## 2.2 Idiosyncratic Risk

New businesses are risky. Many firms get started, lose money over the course of their existence, and then shut down permanently. Entrepreneurs who start these firms lose some or all of the money they invest in the business, and also the opportunity cost of the time they invested in the business.

Figure 1: Firm Survival to Year 8 by Average Profits




The 8-year survival rates of firms in ten bins of average annual net profits. Average annual profits have been winsorized between the 1st and 99th percentiles and then firms are sorted into the ten equally-sized bins between these percentiles. The size of each circle is proportional to the number of observations in that bin.

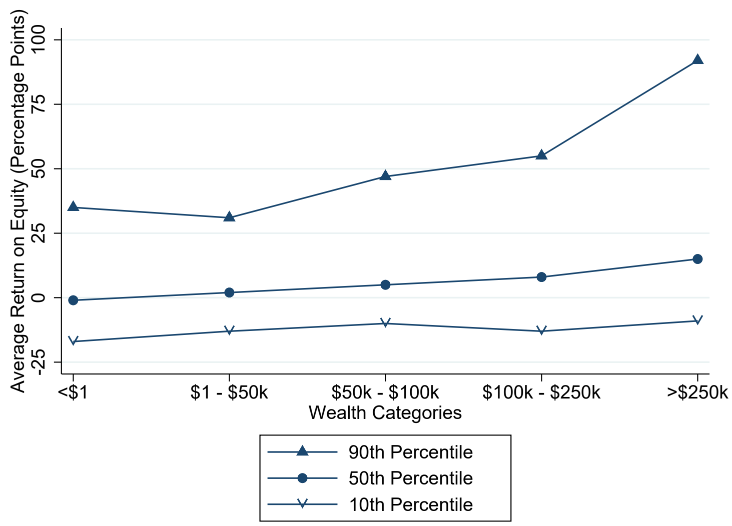
53% of the firms in the Kauffman Firm Survey shut down all operations by the end of their eighth year[3]. In figure 1, I graph firm survival against the average annual amount of profits earned by these new firms over the sample. On the x-axis, I calculate the average annual amount of profits for each firm over all the years that they operate in the sample. I then place firms into 10 bins of equal width and calculate the survival rate of these firms, which is plotted on the y-axis. The size of each circle represents the number of firms in each profit bin. This figure shows that the firms that earn low or negative profits are much less likely to survive, while firms that on average earn positive profits survive at higher rates.

[3]See appendix A.2 for additional details on the calculation of survival.

## 2.3 Heterogeneity in Risk

Different entrepreneurs may start businesses with different levels of risk. More innovative business ideas may have both greater potential for upside and downside. Measuring the degree of idiosyncratic risk is challenging ex-ante without direct measures of entrepreneurial expectations on the dispersion of outcomes, which is not available in the Kauffman Firm Survey. Instead, one way to infer the existence of heterogeneous levels of risk is to examine the dispersion of outcomes ex-post across different groups.

Figure 2: Dispersion in Return on Equity by Entrepreneur's Wealth




The horizontal axis shows five categories of entrepreneur's net worth in the fourth year of operations. The vertical axis shows the average return on equity in percentage points. The plotted points give percentiles of the return on equity, averaged over all years operating in the sample, for each group of entrepreneurs.

In the absence of a market to insure against idiosyncratic business risk, wealthier individuals may be willing to start riskier business, as their wealth allows them to self-insure against the risks. To investigate this, figure 2 compares dispersion in average returns on equity across entrepreneurs with different levels of wealth. For each firm, I compute the average return on equity over all the years they are active in the sample[4]. I then plot the 90$^{th}$, 50$^{th}$, and 10$^{th}$ percentiles of this average return on equity for entrepreneurs with different levels of wealth. The wealth categories are from the fourth year of operations, as this is the earliest year that the Kauffman Firm Survey asks business owners about their wealth.

Figure 2 shows greater dispersion in returns on equity for firms started by higher wealth entrepreneurs. The difference between the 90$^{th}$ percentile firm and the 10$^{th}$ percentile firm is

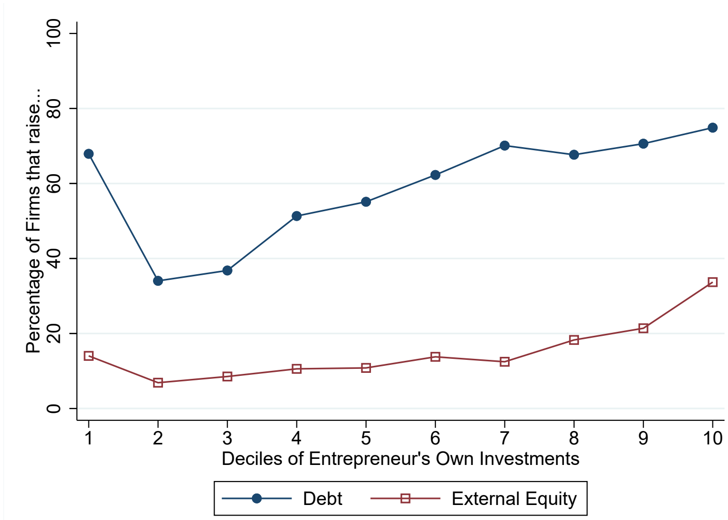
[4]See appendix A.3 for details on how I calculate returns on equity.

101 percentage points for the highest wealth group, and only 52 basis points for the lowest wealth group. This is consistent with the idea that wealthier entrepreneurs choose to start higher risk businesses, which go on to earn more disperse returns.

## 2.4 Sources of Funding

How do new entrepreneurs raise funds to start their businesses? Entrepreneurs invest their own money in 89% of these firms. 15% of new firms raise some external equity from sources beyond the actively managing entrepreneurs such as outside investors, or entrepreneurs' families. 53% of the firms are funded with some debt. Much of this is personal debt, taken out in the entrepreneurs' own name, rather than debt that is owed by the business.

Figure 3: The Proportion of Firms with External Sources of Funding




The proportion of firms that have raised some debt, or some external equity across the distribution of entrepreneur's initial investment. Firms are sorted into deciles based on the total amount of their entrepreneur's own investment in the firm in the first two years of operations.

Entrepreneurs are more likely to raise some funds from other sources if they invest more of their own money in the business. Figure 3 shows the proportion of firms that raise any debt or any external equity for each of the ten deciles of initial investment, defined as the amount of their own money that the entrepreneurs invest in the business within the first two years. While a substantial fraction of entrepreneurs in the lowest bin raise funding from other sources, throughout the rest of the distribution, greater entrepreneurial investment is correlated with a higher probability of raising external sources of funds. On the intensive margin, entrepreneurs who invest more of their own money are also likely to raise larger amounts of money conditional on raising some debt or equity.

Figure 3 suggests that entrepreneurs who invest more of their own money are also able to raise more external funds. This pattern is consistent with the idea that some wealth-poor entrepreneurs may be unable to borrow to finance their business. This idea motivates the modelling of borrowing constraints as a collateral constraint, which allows entrepreneurs to borrow more only as they invest more.

# 3 Dynamic Model

In order to quantify the relative importance of the missing market for entrepreneurial risk and borrowing constraints, I build a dynamic model of entrepreneurial choice where individuals choose whether to be workers or entrepreneurs and entrepreneurs choose the riskiness of the businesses they start.

## 3.1 Environment

There are a unit measure of individuals. Each individual faces a constant probability $(1-\psi)$ of dying every period and has preferences given by:

$$U = \sum_{t=0}^{\infty} (\psi\beta)^t \frac{c^{1-\sigma}}{1-\sigma} \tag{1}$$

Where $\beta$ is the discount factor and $\sigma$ is the coefficient of relative risk aversion.

Each individual has two types of ability, their ability as a worker $(h^W)$ and their ability as an entrepreneur $(h^E)$. At the beginning of each period, an individual will choose whether to operate as a worker or as an entrepreneur for that period. If the individual chooses to be a worker, they will supply labour inelastically and earn $wh^W$, where $w$ is the common wage.

The first period an individual decides to be an entrepreneur, they start a business by both choosing a business risk-type from a menu of risky options $x \in \{x_1, x_2, ..., x_{n_x}\}$ and investing in a capital stock $k$. Once chosen, the business's risk-type $x$ is fixed. In a future period, if an entrepreneur wants to change the risk-type of their business they must shut down their business and liquidate their capital stock before they are able to select a new level of business risk.

After all individuals make an occupational choice and all new entrepreneurs choose both the risk-type of their business and their initial investment level, all individuals receive shocks to both their worker ability $(h^W)$ and their entrepreneurial ability $(h^E)$. While both types of ability are partially persistent, neither are perfectly so, and so individuals face idiosyncratic income risk from choosing either occupation.

In addition, entrepreneurs also receive a project productivity shock ($z$) for their business. This productivity shock ($z$) is drawn from a distribution that depends on the riskiness of their business ($x$). Higher $x$ businesses have higher expected $z$ but also more dispersed $z$. The productivity of a business depends on both the project productivity shock ($z$) as well as the entrepreneur's entrepreneurial ability ($h^E$). Once they received their shocks, entrepreneurs hire an amount of labour ($n$) at wage rate $w$ and produce output ($y$) according to:

$$y = (zh^E)^{1-\gamma}(k^\alpha n^{1-\alpha})^\gamma \tag{2}$$

Note how the project productivity ($z$) and entrepreneurial ability ($h^E$) enter multiplicatively. This means that better entrepreneurs are able both to boost the productivity of successful projects and also to improve business outcomes when businesses are unsuccessful.

After entrepreneurs produce and pay their employees, all individuals make a consumption, savings, and investment decision. The model has two assets. Only entrepreneurs can invest in capital $k$, which depreciates at rate $\delta$. Capital is also illiquid, so that liquidating one unit of capital produces only $\frac{1}{\chi} < 1$ units of consumption.[5] Given an investment of $I$, an entrepreneur's capital stock $k$ evolves according to:

$$k' = \begin{cases} k(1-\delta) + I & \text{if } I \geq 0 \\ k(1-\delta) + \chi I & \text{if } I < 0 \end{cases} \tag{3}$$

In addition to capital, there is also a liquid financial asset $a$ that individuals can save or potentially borrow in. The interest rate on this financial asset is $1 + r^A$ in all states of the world. Borrowing in the financial asset is limited by the following constraint:

$$a \geq -\phi k \tag{4}$$

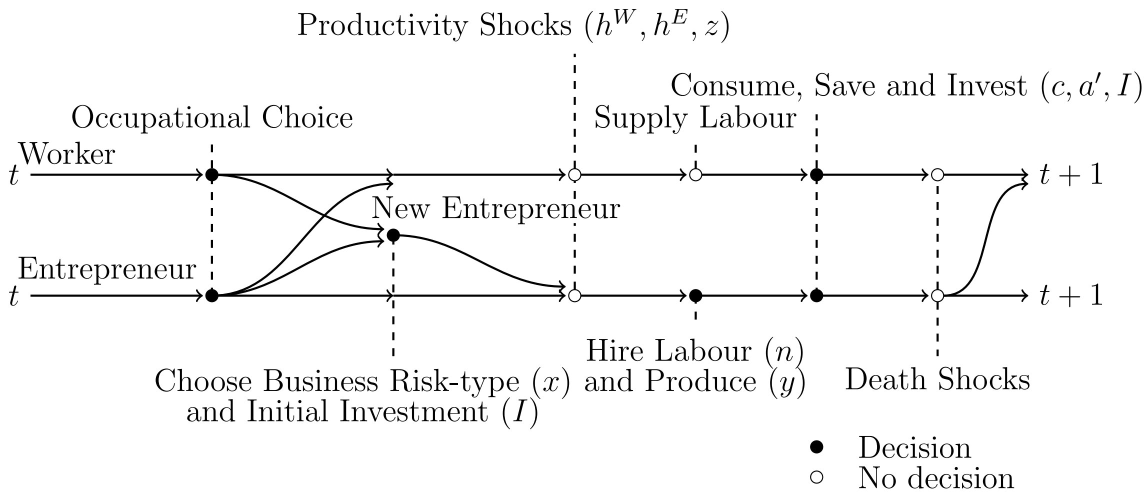
This borrowing constraint restricts how negative the net financial asset position ($a$) can be to a fraction $\phi \in [0, 1]$ of the capital stock.[6] Since workers do not invest in capital ($k = 0$), they must hold a non-negative amount of the financial asset.

After their consumption, savings, and investment decisions, individuals will die with prob-

[5] See Tan (2022) for empirical evidence on capital liquidation costs.

[6] Note that this borrowing constraint is equivalent to a collateral constraint of the form $\left(\frac{1}{1-\phi}\right)$ Wealth $\geq k$, where $\frac{1}{1-\phi} \in [1, \infty)$ and Wealth $= a + k$. This form of collateral constraint is commonly used in the literature, for example by Buera and Shin (2013), Moll (2014), or Guvenen et al. (2023). I write this constraint in the form of a borrowing constraint in order to emphasize that in this model both the level of capital and the net financial position of the liquid assets are state variables that carry across periods.

Figure 4: Timing in the Dynamic Model




ability $(1-\psi)$. If they were an entrepreneur, their invested capital stock is liquidated. All individuals that die are immediately replaced by a descendant who inherits the full value of their liquidated assets. Figure 4 summarizes the timing in the model.

A key departure of this model from classic models of entrepreneurship is how idiosyncratic risk impacts occupational choices. In classic models of selection into entrepreneurship, such as Cagetti and De Nardi (2006), it is typical that the choice to be a worker or an entrepreneur is made after the realization of ability or productivity shocks. In the absence of capital liquidation costs, risk to an individual's entrepreneurial productivity has no impact on the static choice to be a worker or an entrepreneur. By contrast, in this paper's model the productivity shocks occur after the occupational choice. As a result, risk-averse individuals may be willing to choose a lower expected-value occupation if it also has less risk. This paper's model also has capital liquidation costs which generate a similar effect on occupational choice. Choosing to be an entrepreneur today, and investing in a capital stock, creates the risk that in the future, if the individual chooses to shut down their business they will liquidate their capital stock, losing a portion of their wealth.

## 3.2 Individual's Problems

### Worker's Problem

A worker makes a consumption-savings decision, and, at the beginning of the next period, will choose between being a worker ($V^W$) and becoming a new entrepreneur ($V^{NE}$):

$$V^W(a, h^W, h^E) = \max_{a',c} \frac{c^{1-\sigma}}{1-\sigma} + \psi\beta \max\left\{\mathbb{E}\left[V^W(a', h^{W\prime}, h^{E\prime})\right], V^{NE}(a', h^W, h^E)\right\} \tag{5}$$

s.t.

$$a' + c = wh^W + (1 + r^a)a$$

$$a' \geq \underline{a}$$

**New Entrepreneur's Problem**

An individual that has decided to start a new business chooses the risk-type of their business ($x$). Given their current financial assets ($a$), they also choose how much to invest in the business ($I$) and how much to borrow or save in the financial assets ($\tilde{a}$). They will then operate as an entrepreneur later this period with a capital stock ($\tilde{k}$).

$$V^{NE}(a, h^W_{-1}, h^E_{-1}) = \max_{\tilde{a},I,x} \mathbb{E}\left[V^E(\tilde{a}, \tilde{k}, h^W, h^E, z, x)\right] \tag{6}$$

s.t.

$$\tilde{a} = a - I$$

$$\tilde{a} \geq -\phi\tilde{k}$$

$$\tilde{k} = I$$

Note that due to the timing assumption, the new entrepreneur only knows their prior period's abilities ($h^W_{-1}, h^E_{-1}$) at the point when they start the business.

**Entrepreneur's Problem**

An entrepreneur that has an existing business will choose an amount of labour ($n$) to hire, consumption ($c$), savings ($I + a'$), and investment ($I$). At the beginning of the next period, they will choose between shutting down their business to become a worker ($V^W$), shutting down their business to start a new business ($V^{NE}$) and continuing to operate the same business ($V^E$).

$$V^E(a,k,h^W,h^E,z,x) \quad = \quad \max_{n,c,a',I} \frac{c^{1-\sigma}}{1-\sigma} \;+\; \psi\beta \max \left\{ \begin{array}{c} \mathbb{E}\left[V^W(a',h^{W\prime},h^{E\prime})\right], \\ \\ V^{NE}(a',h^W,h^E), \\ \\ \mathbb{E}\left[V^E(a',k',h^{W\prime},h^{E\prime},z',x)\right] \end{array} \right\} \tag{7}$$

s.t.

$$c + a' + I = (zh^E)^{1-\gamma}(k^\alpha n^{1-\alpha})^\gamma - wn + (1+r^a)a$$

$$a' \geq -\phi k'$$

$$k' = \begin{cases} k(1-\delta) + I & \text{if } I \geq 0 \\ k(1-\delta) + \chi I & \text{if } I < 0 \end{cases}$$

Note that if the entrepreneur decides to start a new business, they cannot use the same capital from their current business. They must first fully liquidate it and then invest in a new capital stock for the new business.

### 3.3 Equilibrium

An equilibrium is a set of value functions $\{V^W, V^{NE}, V^E\}$, occupational choices, a set of policy functions $\{c^W, a'^W, \tilde{a}^{NE}, I^{NE}, x^{NE}, c^E, a'^E, I^E, n^E\}$, a distribution of agents $\{\Gamma^E(a,k,h^W,h^E,z,x), \Gamma^W(a,h^W,h^E)\}$, and a wage $w$ such that

1. The policy functions solve the individual's problems given by (5), (6) and (7).

2. Markets clear:

   - Labour

$$\int h^W d\Gamma^W(a,h^W,h^E) = \int n^E d\Gamma^E(a,k,h^W,h^E,z,x)$$

   - Final Goods

$$\begin{aligned} \int (c+a')d\Gamma^W(a,h^W,h^E) + \int (c+a'+I)d\Gamma^E(a,k,h^W,h^E,z,x) = \\ \int \left((zh^E)^{1-\gamma}(k^\alpha n^{1-\alpha})^\gamma + (1+r^A)a\right) d\Gamma^E(a,k,h^W,h^E,z,x) \\ + \int ((1+r^A)a)d\Gamma^W(a,h^W,h^E) \end{aligned}$$

3. The distribution of agents is stationary

$$\Gamma^E(a,k,h^W,h^E,z,x) = \Gamma^{E\prime}(a,k,h^W,h^E,z,x)$$

$$\Gamma^W(a,h^W,h^E) = \Gamma^{W\prime}(a,h^W,h^E)$$

Note that I assume the economy is a small open economy, and so the financial asset can be in net positive or negative supply. In section 6.2, I relax this assumption.

# 4 Calibration

In this section, I describe how I parameterize and calibrate the model using micro data on new firms and wealth.

## 4.1 Parameterization

I parameterize both the worker and entrepreneurial ability processes with AR(1) processes:

$$\log(h^{i\prime}) = \rho_{h^i}\log(h^i) + \epsilon_{h^i}$$

where $\epsilon_{h^i} \sim N\left(\frac{\mu_{h^i}}{1-\rho_{h^i}}, \sigma^2_{h^i}\right)$ for $i \in \{E, W\}$. I assume that the two types of abilities are uncorrelated.[7]

In order to keep the problem computationally tractable, the entrepreneurs choose between two project types, a relatively safe project ($x_1$) and a relatively risky project ($x_2$). Each project type receives productivity shocks $z$ the follows an AR(1) process:

$$\log(z') = \rho_{z|x_i}\log(z) + \epsilon_{z|x_i}$$

$$\epsilon_{z|x_i} \sim N\left(\frac{\mu_{z|x_i}}{1-\rho_{z|x_i}}, \sigma^2_{\epsilon_z|x_i}\right)$$

for $i \in \{1, 2\}$.

I use the Rowenhorst method to discretize these four AR(1) processes $\{h^W, h^E, z_{x_1}, z_{x_2}\}$.

[7]This assumption is also made by Cagetti and De Nardi (2006) and Brüggemann (2021). Allub and Erosa (2019) calibrate a model of entrepreneurs and workers to Brazilian data on transition rates across occupations and differences in earnings. They find a low correlation of 0.145.

## 4.2 Calibration Strategy

There are two groups of parameters. For the first group of ten parameters, I take some commonly used values from the literature. The remaining eleven parameters, I jointly calibrate to identifying moments from two data sets. I use seven statistics from the Kauffman Firm Survey to discipline the degree of idiosyncratic risk in the productivity processes plus the entrepreneurial borrowing constraints. I then use four statistics from the 2004 Survey of Consumer Finances to discipline the degree of wealth inequality in the model and the remaining parameters. I use the 2004 wave of the Survey of Consumer Finances as it represents the distribution of wealth in the year that all of the Kauffman Firm Survey firms were founded.

#### Externally Chosen Parameters

A period in the model is a year. I set the capital share $\alpha$ to $\frac{1}{3}$ and the interest rate $r^A$ to 4% per year. I set the decreasing returns to scale parameter $\gamma$ to 0.88 and the depreciation rate to 6% per year. The time discount factor is set such that $\beta = \frac{1}{1+r^A}$. Since higher degrees of risk aversion will tend to amplify the importance of the missing market for risk, I set the coefficient of relative risk aversion to be relatively conservative at $\sigma = 1.50$.

I set the probability of death $(1 - \psi)$ to $\frac{1}{40}$ so that the expected working lifetime is 40 years. The persistence of the labour income process $\rho_{\epsilon_h}$ is set to to 0.9, which is in the range of empirical estimates according to Guvenen (2007). The standard deviation of the innovation $\sigma_{\epsilon_h W}$ is set to 0.2.

#### Internally Calibrated Parameters

In the steady-state of the model, I simulate an eight year panel of new firms, corresponding to the Kauffman Firm Survey's eight year panel. This allows me to construct analogous moments between the data and the model. To discipline the tightness of entrepreneurial borrowing constraints, I target the ratio of the average level of equity to the average level of debt for firms in the first year of operations in the Kauffman Firm Survey.

To discipline the productivity processes for project productivity $\{z_{x_1}, z_{x_2}\}$, I use a series of six moments. The risk-reward trade-off between these two projects is a key input into the model. Unfortunately, it is not possible to directly observe the distribution of risk each entrepreneur is drawing from. However, the distribution of firm outcomes is informative about the nature of entrepreneurial risk that all entrepreneurs are facing. The model predicts that higher wealth individuals will both be able to invest more in their firms, because they are better able to self-finance, and also more willing to take risk, because they are better able to self-insure. I therefore split the firms by the level of initial investment that entrepreneurs bring into the firm

Table 1: Benchmark Calibration

| Target | Data | Model | Parameter | Value |
|---|---|---|---|---|
| **Exogenously Calibrated** | | | | |
| Probability of Death | | | $1-\psi$ | 2.5 % |
| Interest Rate | | | $r^A$ | 4.0 % |
| Depreciation | | | $\delta$ | 6.0 % |
| Capital Share | | | $\alpha$ | 0.33 |
| Returns to Scale | | | $\gamma$ | 0.88 |
| Discount Factor | | | $\beta$ | 0.96 |
| Coefficient of Relative Risk Aversion | | | $\sigma$ | 1.50 |
| Average Labour Ability | | | $\mu_{h^W}$ | 1.00 |
| Dispersion of Labour Ability | | | $\sigma_{h^W}$ | 0.20 |
| Persistence of Labour Ability | | | $\rho_{h^W}$ | 0.90 |
| **Endogenously Calibrated** | | | | |
| **KFS Moments** | | | | |
| Ratio of Average Debt to Average Equity | 1.2 | 1.1 | $\phi$ | 0.61 |
| Relative Employment (High-to-Low Investment) | 4.0 | 3.6 | $\mu_{z\|x_1}$ | 2.28 |
| 90th percentile of Investment to GDP | 4.9 | 5.5 | $\mu_{z\|x_2}$ | -3.79 |
| Autocorrelation of Employment (Low Investment) | 0.77 | 0.78 | $\sigma_{z\|x_1}$ | 0.10 |
| Autocorrelation of Employment (High Investment) | 0.79 | 0.60 | $\sigma_{z\|x_2}$ | 5.46 |
| Survival Rate % (Low Investment) | 47 | 40 | $\rho_{z\|x_1}$ | 0.57 |
| Survival Rate % (High Investment) | 55 | 51 | $\rho_{z\|x_2}$ | 0.93 |
| **SCF Moments** | | | | |
| Wealth Ratio of Entrepreneurs to Workers | 7.0 | 7.5 | $\mu_{h^E}$ | -2.51 |
| Wealth Gini | 0.79 | 0.78 | $\rho_{h^E}$ | 0.96 |
| Proportion of Entrepreneurs in Wealthiest 1% | 74 | 65 | $\sigma_{h^E}$ | 1.58 |
| Proportion of Entrepreneurs | 12 | 14 | $\chi$ | 1.09 |

from their own personal finances. I label firms in the bottom 90% of entrepreneur's own initial investment distribution low-investment firms and the remainder high-investment firms.

I calculate the relative employment of these high-investment and low-investment firms and well as the ratio of the 90$^{\text{th}}$ percentile of total investment[8] to GDP, to pin down the levels of these two productivity processes. I then calculate the autocorrelation of employment over time to discipline the standard deviations of the processes. I also compute the eight-year survival rates of these firms to discipline the autocorrelation of the processes.

To discipline the entrepreneurial ability process and the level of capital liquidation costs, I use statistics from the Survey of Consumer Finances. Wealth plays a key role in the model in generating selection into entrepreneurship, since wealth helps mitigate both of the financial frictions. I target the ratio of the average wealth of entrepreneurs to the average wealth of workers, the Gini coefficient for wealth, the proportion of entrepreneurs in the wealthiest 1%

[8] Total investment includes both the entrepreneur's own investments plus the debt and external equity they raise.

and the proportion of entrepreneurs in the overall economy.

## 4.3 Model Fit

In this subsection, I compare the fit of the model to untargeted statistics. Firstly, I compare the firm size distribution for firms in the data and in the model. In both the Kauffman Firm Survey data and in the model, I compute the proportion of firm-year observations that fall into five different employment size bins, over the first eight years after starting a business. Table 2 reports the results.

Table 2: Firm Size Distribution Distribution

| | <1 | 1-4 | 5-9 | 10-19 | 20+ |
|---|---|---|---|---|---|
| KFS Data | 47.1 | 36.3 | 9.1 | 4.4 | 3.2 |
| Model | 47.4 | 23.1 | 26.7 | 0.8 | 2.0 |

In the model 47.4% of firms employ less than one worker[9], closely matching the 47.1% of firms in the Kauffman Firm Survey panel who are non-employers. The model does generate too many firms in the 5-9 employment size bin, and not enough in the larger size bins. Overall though, the model does a good job at generating the skewed distribution of sizes for new firms.

Secondly, I compare the distribution of income and wealth in the data and the model. While the calibration strategy does directly target the wealth Gini, it does not target any income statistics or wealth shares.

Table 3: Income and Wealth Distribution

| | Income Share of Top | | | | |
|---|---|---|---|---|---|
| | 1% | 5% | 10% | 20% | 50% |
| Model | 10 | 22 | 33 | 44 | 70 |
| SCF (2004) | 16 | 30 | 40 | 56 | 83 |
| | Wealth Share of Top | | | | |
| | 1% | 5% | 10% | 20% | 50% |
| Model | 26 | 50 | 65 | 81 | 98 |
| SCF (2004) | 34 | 59 | 71 | 84 | 98 |

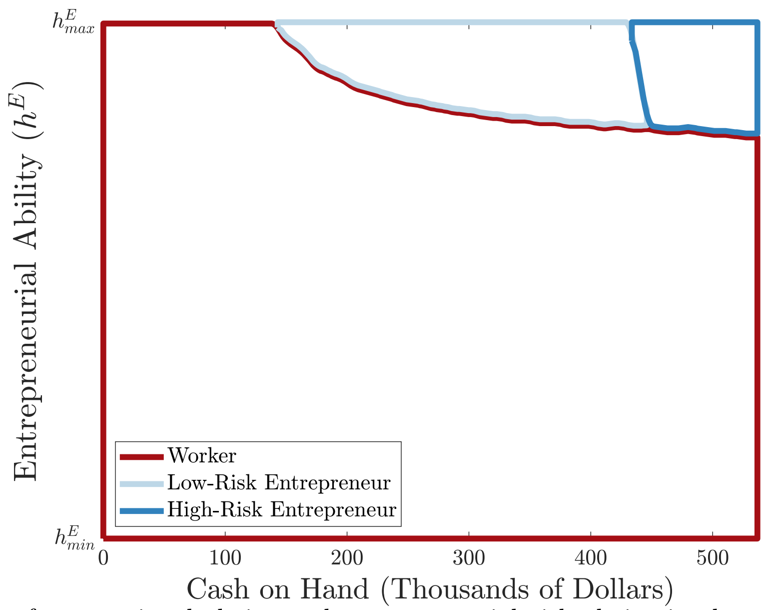
For both the income and wealth distribution the model generates a large degree of inequality. It misses the top 1% income share by 6 percentage points and the top 1% wealth share by 8 percentage points. Overall, the model features a realistic dispersion in both income and wealth.

[9]This means that they employ an amount of efficiency units of labour less that the average worker ability.

### 4.4 Model Outcomes

In this subsection, I describe how wealth impacts entrepreneurial choices and outcomes in the calibrated economy.

Figure 5: Patterns of Occupational Selection and Risk Choice in the Model




Patterns of occupational choice and entrepreneurial risk choice in the calibrated model. Given a worker with the median worker ability ($h^W$), the graph shows how the worker would select their occupation depending on their current level of entrepreneurial productivity ($h^E$) and their current cash on hand ($a(1+r^A)+wh^W$).

Each period, based on their two abilities and their current level of wealth, individuals in the model must choose whether to be a worker or an entrepreneur, and if they become an entrepreneur their level of business risk ($x$). Figure 5 illustrates these choices in the model. For a worker with the median worker ability ($h^W$), the graph shows their occupational choice depending on their level of entrepreneurial productivity ($h^E$) and their current level of cash on hand, which is equal to their wealth plus their current income.

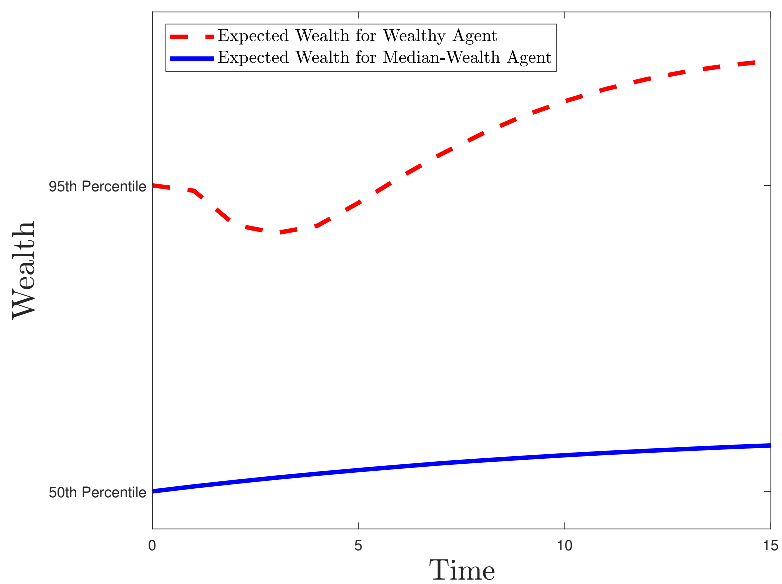
An individual with low entrepreneurial ability ($h^E$) will become a worker regardless of their wealth. By contrast, an individual with high entrepreneurial ability will choose depending on their level of wealth. If the individual has little wealth, they will choose to be a worker. They will do so because both financial frictions reduce the value of entrepreneurship. The borrowing constraint limits the scale of the business a poor entrepreneur can operate, which limits their entrepreneurial income. Additionally, if the business fails, the poor entrepreneur will earn very low income that period and consume very little without access to insurance.

An individual with high entrepreneurial ability and moderate wealth will choose to be an entrepreneur operating the low-risk project. Moderate wealth allows them to self-finance a sufficient amount of capital. However, the inability to insure against business risk means that they will choose the low-risk project. Even though the high-risk project has higher expected productivity, its higher level of risk makes it unattractive. A bad productivity shock would leave the entrepreneur with low income for at least one period, and if the shock was low enough that they decided to exit, the entrepreneur would have to liquidate their capital stock, leading to a loss of wealth.

An individual with high entrepreneurial ability and high wealth will choose to be an entrepreneur operating the high-risk project. Since they have sufficient wealth to self-insure any bad productivity shocks, they choose the higher-risk project with higher expected productivity.

Given these choices, wealthier individuals will, on average, accumulate wealth faster than poor individuals with the same abilities. Figure 6 illustrates this dynamic for two individuals born with identical entrepreneurial and worker abilities. Both individuals are born at time zero as workers with the maximum entrepreneurial and worker ability. However, they are endowed with different initial levels of wealth, one born with an inheritance equal to the median level of wealth in the economy and one born with an inheritance equal to the 95$^{\text{th}}$ percentile of wealth in the economy.

Figure 6: Wealth Accumulation for Individuals with Different Initial Wealth




Graph shows the patterns of wealth accumulation for two individuals. One is born with the median level of wealth in the economy and one born with an inheritance equal to the 95$^{\text{th}}$ percentile of wealth in the economy. The two lines correspond to the average level of wealth given all the possible shocks to their abilities and business productivities that they could receive.

The wealthier individual immediately starts a high-risk business. They have some probability of receiving initial productivity shocks low enough that they will shut down their business, liquidate their capital and start a new high-risk business next period. This process is costly, and so on average the wealth of the wealthy individual declines briefly. As soon as they start a business that turns out to be successful, they tend to stay in business, receiving high productivity and earning high returns on their wealth. The wealthy individual then saves a high proportion of their entrepreneurial income for two reasons. First, because the project is still risky, the individual wants to engage in precautionary savings in order to self-insure against the project's failure. Second, because of the borrowing constraint, the entrepreneur wants to save more in order to operate a larger business next period and earn an even higher income. As a consequence the wealthy individual accumulates wealth quickly.

The individual born with median wealth initially chooses to be a worker, and saves up to become an entrepreneur in the future. Depending on their shocks, they will likely start a business after a few periods of saving. However, when they choose to do so they will start the low-risk business. Starting the high-risk business is simply too risky, as low productivity shocks would induce them to liquidate their capital and exit after having earned little, or even lost money, in that period. As time progresses, these entrepreneurs continue to save. Some of the luckier individual eventually go on to accumulate enough wealth to start the high-risk business, but many remain with the low-risk business.

# 5 Quantitative Analysis

In this section I measure the quantitative significance of the two financial frictions, the missing market for risk and entrepreneurial borrowing constraints, for aggregate economic outcomes. To do so, I first remove one, then the other, and finally both from the model in order to compare the resulting steady-state equilibria to the benchmark economy with both financial frictions.

First, I complete this missing market by introducing state-contingent assets. In the benchmark economy, there is a single risk-free asset. In the complete markets economy, each individual can purchase assets that pay off in future states of the world based on their individual realizations of $h^W, h^E$ and $z$. An asset $a_i$ pays off $1 + r^A$ in the state of the world $i \in H^W \times H^E \times Z$. Each of these assets is sold at an actuarially fair price $q_i$ by competitive risk-neutral financial intermediaries.

$$q(h^{W\prime}, h^{E\prime}, z') = \text{Prob}(h^{W\prime}, h^{E\prime}, z' | h^W, h^E, z, x) \tag{8}$$

In order to separate the impact of the missing market for risk from the impact of the entrepreneurial borrowing constraint, I initially keep the borrowing constraint in the economy unchanged. In the benchmark economy, the borrowing constraint requires that $a \geq -\phi k$. In the complete markets economy, the borrowing constraint requires that:

$$\sum_i q_i a_i \geq -\phi k \tag{9}$$

Therefore, an entrepreneur with the same net worth in both economies can invest in the same maximum amount of capital.

In this complete markets economy, I assume that these financial intermediaries have perfect information over the abilities of potential entrepreneurs and the expected productivity of these projects. This experiment therefore measures an upper bound on the potential benefits of providing additional insurance to entrepreneurs, as access to this degree of information is unrealistic. However, understanding the size of the potential gains helps us understand which financial frictions public policy should aim to mitigate. In section 7, I consider the policy implications of these frictions without requiring that a government have perfect information about private individuals.

Second, I relax the entrepreneurial borrowing constraints that limits entrepreneurial investment by setting $\phi = 1$, so that entrepreneurs can borrow against the full value of their capital. Note that while this relaxes the entrepreneur's borrowing constraint for investment in capital, workers and entrepreneurs are still unable to borrow using unsecured debt. This experiment therefore is focused on borrowing constraints specifically that prevent entrepreneurial investment, as has been the subject of study in a large literature (Buera et al., 2015), rather than more general borrowing constraints that apply to individuals for consumption.

I then compare the steady-states of four economies. The benchmark economy with both financial frictions, a complete markets economy where state-contingent assets complete the missing market for risk but entrepreneurs still face borrowing constraints ($\phi < 1$), the relaxed borrowing constraints economy where entrepreneurs can borrow the full value of their capital ($\phi = 1$) but there is a missing market for risk, and finally an economy with neither friction with both a complete market for risk and unrestricted capital investment ($\phi = 1$). Table 4 reports the changes in aggregate output, wages, capital stock, and productivity in the steady-states of these four economies relative to the benchmark economy.

In the complete markets economy aggregate output is 7.7% higher than in the benchmark economy, despite a decline in the aggregate capital stock. This large increase in output is driven by a substantial increase in aggregate productivity of 9.0%. Access to state-contingent insurance encourages all entrepreneurs to operate the high-risk project, as shown in table 5. With more high-risk projects getting started, the distribution of firm-level productivities in the economy improves and so aggregate productivity rises.

As existing entrepreneurs operate more productive firms and invest more, aggregate labour

Table 4: Change in Aggregate Outcomes

| | Output | Productivity | Capital | Wage Rate |
|---|---|---|---|---|
| Benchmark Economy | 0.0 | 0.0 | 0.0 | 0.0 |
| Complete Markets | 7.7 | 9.0 | −3.4 | 8.1 |
| Relaxed Borrowing Constraints | 2.9 | 1.3 | 11.8 | 6.0 |
| Neither Friction | 14.0 | 12.0 | 8.6 | 15.2 |

All numbers are percent changes relative to the benchmark economy.

Table 5: Occupational and Risk Choices

| | Percentage of | | Entrepreneurs operating | |
|---|---|---|---|---|
| | Workers | Entrepreneurs | Low-Risk | High-Risk |
| Benchmark Economy | 85.5 | 14.5 | 12.4 | 2.1 |
| Complete Markets | 84.5 | 15.5 | 0.0 | 15.5 |
| Relaxed Borrowing Constraints | 82.3 | 17.7 | 17.4 | 0.3 |
| Neither Friction | 83.8 | 16.2 | 0.0 | 16.2 |

demand increases substantially. In response, the wage rate rises by 8.1% to clear the labour market. Higher wages mean that less productive entrepreneurs face higher labour costs and a rising opportunity cost. Many of them choose to exit and enter the labour market. As a result, less productive entrepreneurs are effectively crowded out by more productive entrepreneurs through the equilibrium in the labour market. While the stock of capital increases substantially in partial equilibrium, the rising wage rate reduces entrepreneur's incentives to invest in capital. As a result, the aggregate stock of capital in the economy falls by 3.4%. Despite this decline, the increases in productivity more than make up for this in terms of output.

In the relaxed borrowing constraints economy aggregate output increases by 2.9%. Most of this gain comes from a larger capital stock. Relaxing borrowing constraints allows formerly constrained entrepreneurs to invest in more capital, leading to an increase in the aggregate capital stock of 11.8%. Aggregate productivity also increases by 1.3%, which is mostly driven by improved selection. Borrowing constraints are a major barrier to starting a business for low-wealth high-ability individuals. Without these constraints, more high-ability low-wealth individuals become entrepreneurs, improving the ability distribution of entrepreneurs. More entrepreneurs and higher investment lead to large increases in aggregate labour demand, leading wages to rise by 6.0%.

In the economy with neither friction, aggregate output increases by 14.0%, boosted both by a substantial increase in aggregate productivity and increase in the aggregate capital stock.

The increase in aggregate productivity is driven by both entrepreneurs increasingly choosing the high-risk project but also because selection improves. Significantly higher labour demand from more entrepreneurs and more investment leads to substantial wage gains in equilibrium, with the wage rate rising by 15.2%. Note how the total increase in output in the neither frictions case is much greater at 14.0% than the sum of the individual effects of completing the missing market (7.7%) or relaxing the borrowing constraints (2.9%). This suggest that these two financial frictions interact in an important way.

Table 6: Wealth Inequality

| | Wealth Share of Top | | | | |
|---|---|---|---|---|---|
| | 1% | 5% | 10% | 20% | 50% |
| Benchmark | 26 | 50 | 65 | 81 | 98 |
| Contingent Claims | 11 | 38 | 61 | 86 | 99 |
| No Borrowing Constraint | 11 | 31 | 49 | 70 | 95 |
| Frictionless | 9 | 34 | 54 | 79 | 99 |

Table 6 reports statistics about the distribution of wealth in the four economies. Completing the missing market substantially reduces wealth inequality relative to the benchmark economy. The share of wealth owned by the wealthiest 1% declines from 26% down to 11%. This means that completing the missing market for risk delivers a rare equity-efficiency win-win, where both aggregate productivity is higher and wealth inequality is lower.

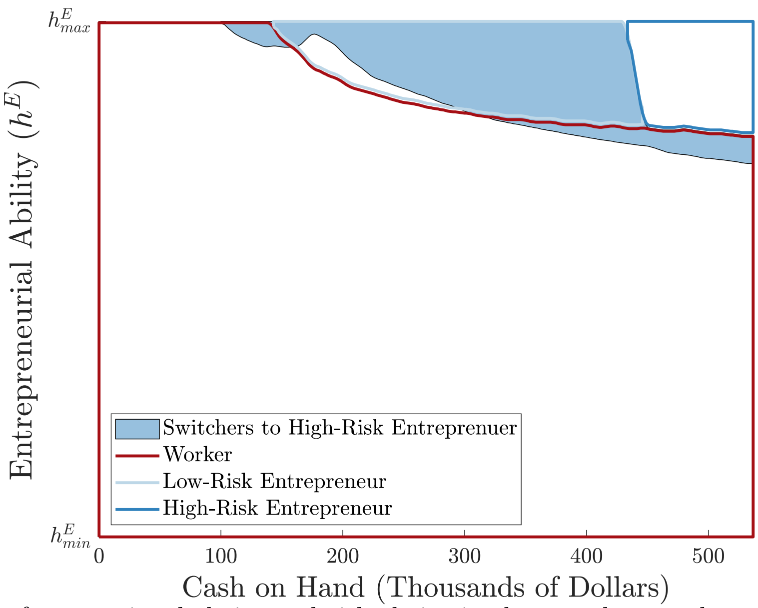
This substantial decline in inequality occurs for two reasons. Firstly, completing the missing market for risk eliminates an important source of rate of return heterogeneity. As illustrated by figure 6, in the benchmark economy wealthier entrepreneurs earn higher average rates of return on their wealth because they start higher-risk businesses. By contrast, under complete markets, all entrepreneurs now choose high-risk projects. Secondly, the ability of individual entrepreneurs to purchase actuarially fair insurance mechanically reduces dispersion in outcomes. Successful entrepreneurs pay premiums while unsuccessful entrepreneurs receive payouts, which substantially reduces dispersion in outcomes.

Relaxing the borrowing constraints has a similar effect on wealth inequality in this economy. The share of wealth owned by the wealthiest 1% also coincidentally declines to 11%. As low-wealth individuals are able to borrow more, far more individuals choose to enter entrepreneurship and start low-risk businesses. The resulting increased labour demand increase wages substantially. Higher wages make entrepreneurship less profitable, leading to lower wealth accumulation by entrepreneurs. As a result, fewer high-risk businesses are started in equilibrium. As a result, wealth inequality falls substantially.

In subsections 5.1, 5.2, and 5.3, I illustrate how these changes in aggregate quantities are related to the decisions of individuals under the different financial frictions. Throughout these subsections, I keep the wage constant at the benchmark economy's equilibrium level, in order to directly show the impact of removing the frictions.

## 5.1 Completing the Missing Market for Risk

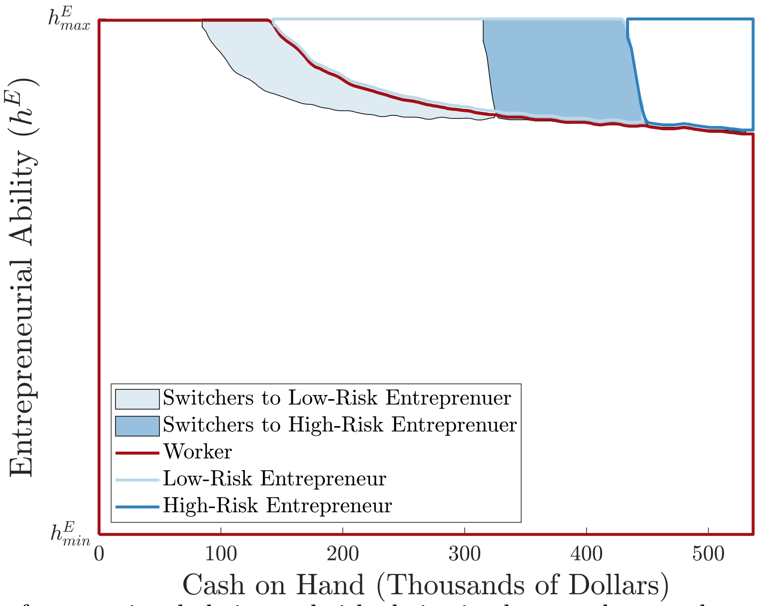
Figure 7: Comparing Occupational Choice and Endogenous Risk Choice: Complete Markets




Patterns of occupational choice and risk choice in the complete markets economy. Switchers to High-Risk Entrepreneur is the region of the state space where individuals choose to start the high-risk project in the complete markets economy, but do not choose that option in the benchmark economy. This comparison is in partial equilibrium, so that the wage rate is equal to its level in the benchmark economy.

Figure 7 compares the patterns of occupational choice and endogenous risk choice between the benchmark economy and the economy with a complete market for risk in partial equilibrium. In the economy with complete markets, more entrepreneurs choose the riskier project with higher expected productivity. They then insure themselves against the substantial risks associated with this project using the state-contingent assets. Some of highest ability individuals who previously would have chosen to be workers because of their moderate wealth levels, choose instead to become entrepreneurs. Even though borrowing constraints still require them to self-finance the capital stock, without the need to self-insure, they find it worthwhile to start a business.

Figure 8: Comparing Occupational Choice and Endogenous Risk Choice: Relaxed Borrowing Constraints




Patterns of occupational choice and risk choice in the complete markets economy. Switchers to Low-Risk Entrepreneur is the region of the state space where individuals choose to start the low-risk project in the no-borrowing constraints economy, but do not choose that option in the benchmark economy. Switchers to High-Risk Entrepreneur is the analogous region for the high-risk project. This comparison is in partial equilibrium, so that the wage rate is equal to its level in the benchmark economy.

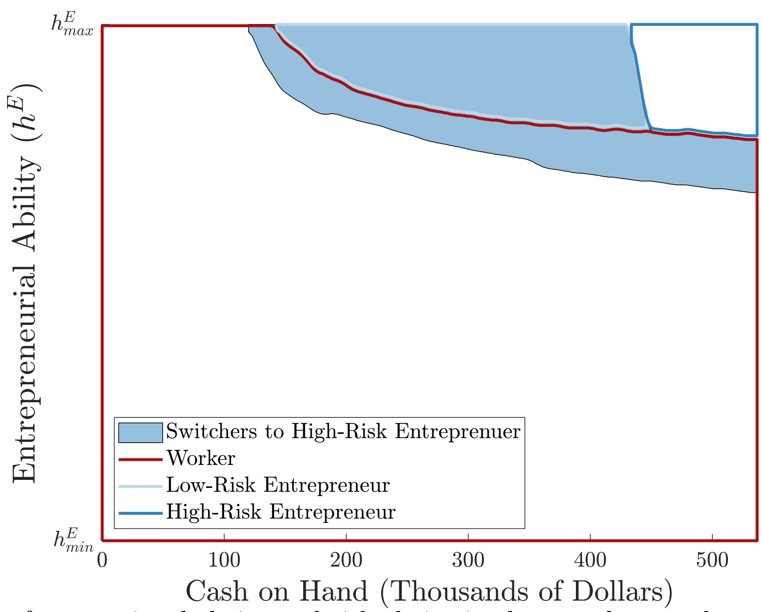
## 5.2 Relaxing The Borrowing Constraints

Figure 8 compares the patterns of occupational choice and endogenous risk choice between the benchmark economy and the economy with relaxed borrowing constraints in partial equilibrium. Without borrowing constraints limiting the capital stock they can invest in, many more wealth-poor individuals with high entrepreneurial ability switch from being workers to being entrepreneurs. They do so because they are now able to operate much larger scale businesses and so generate far more entrepreneurial income.

In partial equilibrium, relaxing the borrowing constraints also induced a substantial fraction of moderately-wealthy entrepreneurs to switch from the low-risk project to the high-risk project. With borrowing constraints, if a moderately-wealthy entrepreneur starts a high-risk project, receives a bad productivity shock and loses wealth, either through consuming out of their savings or because they must liquidate their capital stock, the next business they start must be operated at an even smaller scale because of their limited wealth. Without borrowing constraints, this negative effect on serial entrepreneurship doesn't take place, as entrepreneurs are able to operate subsequent businesses at any scale. As a consequence, removing the borrowing constraints encourages lower wealth entrepreneurs to start the high-risk project.

## 5.3 Neither Financial Friction

Figure 9: Comparing Occupational Choice and Endogenous Risk Choice: Neither Financial Friction




Patterns of occupational choice and risk choice in the complete markets economy. Switchers to High-Risk Entrepreneur is the region of the state space where individuals choose to start the high-risk project in the neither financial friction economy, but do not choose that option in the benchmark economy. This comparison is in partial equilibrium, so that the wage rate is equal to its level in the benchmark economy.

Figure 9 compares the patterns of occupational choice and endogenous risk choice between the benchmark economy and the economy with neither financial friction in partial equilibrium. Due to the availability of state-contingent assets, no entrepreneurs will choose to start the low-risk business. The lack of entrepreneurial borrowing constraints means that poorer individuals are also more willing to become entrepreneurs. Despite the absence of these two frictions, wealth still plays a role in determining both occupational selection and the endogenous choice of risk. This is due to the presence of the unsecured borrowing limit, but the role of wealth is greatly diminished due to the removal of the two main financial frictions.

# 6 Quantitative Robustness

## 6.1 No Endogenous Choice of Risk

In this subsection, I study the impact of the missing market for entrepreneurial risk in an economy without an endogenous choice of risk. In the benchmark economy in section 3, entrepreneurs endogenously choose from a menu of different risky projects ($x \in \{x_1, x_2\}$). In this subsection, I remove this endogenous choice and consider an economy where entrepreneurs have access to only one type of risky business $x \in \{x_1\}$. I re-calibrate this economy to the same set of moments as in section 4. See appendix B for the details of this calibration.

I then perform the same quantitative analysis as in section 5 on this economy with a single entrepreneurial project type. Table 7 reports the steady-states of four economies. The one-project economy with both financial frictions, a one-project complete markets economy where state-contingent assets complete the missing market for risk but entrepreneurs still face borrowing constraints ($\phi < 1$), a one-project relaxed borrowing constraints economy where entrepreneurs can borrow the full value of their capital ($\phi = 1$) but there are no state-contingent assets, and finally a one-project neither friction economy with both a complete market for risk and unrestricted capital investment ($\phi = 1$).

Table 7: Change in Aggregate Outcomes in the One-Project Economy

| | Output | Productivity | Capital | Wages | Workers | Entrepreneurs |
|---|---|---|---|---|---|---|
| One-Project Economy | 0.0 | 0.0 | 0.0 | 0.0 | 84.5 | 15.5 |
| Complete Markets | 0.8 | 3.7 | -4.9 | 3.1 | 81.1 | 18.9 |
| Relaxed Borrowing Constraints | 3.2 | 2.9 | 4.6 | 5.0 | 83.1 | 16.9 |
| Neither Friction | 5.0 | 4.1 | 6.9 | 6.9 | 81.8 | 18.2 |

All numbers are percent changes relative to the one-project economy with both financial frictions.

The gains to aggregate productivity from completing the missing market for risk are smaller in the absence of the endogenous choice of risky projects. In the economy with the endogenous choice of risk, completing the missing market raises aggregate productivity by 9.0%, while the gain is only 3.7% without the endogenous choice of risk. This reflects the important role that the endogenous choice of risky projects has in the benchmark economy.

However, even in the absence of the endogenous choice of risk, completing the missing market still produces a larger increase in aggregate productivity (3.7%) than relaxing the borrowing constraints (2.9%). Even in the absence of an endogenous choice of risky projects, the missing market for entrepreneurial risk significantly distorts entrepreneurial decisions. It does so primarily through discouraging capital investment by unconstrained entrepreneurs, but also through the extensive margin, where it discourages entry into entrepreneurship.

Of course, the two experiments have different implications for the stock of capital. While in partial equilibrium, both experiments substantially increase entrepreneurship and investment in capital, rising wages in the labour market causes the complete markets equilibrium to have a lower aggregate capital stock. As a result, the overall gain to aggregate output from completing the missing market is much less at 0.8% compared to relaxing the borrowing constraint, which increases steady-state output by 3.2%.

Together, removing both frictions increase aggregate output by 5.0%, which is larger than the sum of the two individual effects. This result demonstrates that the interaction effect between the missing market for risk and entrepreneurial borrowing constraints does not operate solely through the endogenous choice of risk.

## 6.2 Adding a Corporate Sector and Clearing the Asset Market

In the benchmark economy in section 3, a unit mass of individuals choose to be entrepreneurs or workers. In equilibrium, the entrepreneurs hire all workers so that the labour market clears. In the real economy, many workers are employed by large publicly-listed firms that face much lower degrees of financial frictions than privately-held firms.[10] In this subsection, I add a representative corporate firm that faces no financial frictions to the economy. This corporate firm represents the public firms that employ 31% of the non-government labour force in the US (Asker et al., 2015).

The representative corporate firm chooses an amount of labour $N_C$ to hire and an amount of capital to rent $K_C$ in order to maximize their static profits:

$$\Pi_C = \max_{K_C, N_C} A_C K_C^{\alpha} N_C^{1-\alpha} - (r^a + \delta) K_C - w N_C \tag{10}$$

Note that this corporate firm faces no borrowing constraints and no missing market for idiosyncratic risk. The corporate firm has no direct impact on the individual's problem but influences the general equilibrium determination of prices, as it is a significant source of both labour and asset demand.

Additional, in this version of the economy, I also clear the asset market. In equilibrium, asset demand from borrowing entrepreneurs and the corporate firm must be equal to asset supply from saving entrepreneurs and workers. A complete equilibrium definition for this version of the economy is presented in appendix B.2.

I recalibrate this economy to the same set of moments as the benchmark economy as described in appendix B.2, and then I run the same quantitative exercise as in section 5.

[10] See Ayerst and Robinson (2024) for empirical evidence of lower levels of financial frictions facing public firms compared to private firms.

Table 8: Change in Aggregate Outcomes in the Corporate Sector Economy

| | Output | Percentage Change Productivity | Capital | Wage Rate | Percentage Points Interest Rate |
|---|---|---|---|---|---|
| Corporate Sector Economy | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Complete Markets | 2.4 | 27.2 | −10.4 | 4.7 | −1.3 |
| Relaxed Borrowing Constraints | 1.5 | 26.0 | −8.8 | 4.7 | 0.1 |

The first four columns are percent changes relative to the benchmark economy. The last column shows the change in percentage points of the interest rate, which is 4.3% in the calibrated corporate sector economy with both financial frictions.

Table 8 shows the changes in aggregate quantities when I complete the missing market for risk as well as when I relax the borrowing constraints in this corporate sector economy. When I complete the missing market for risk, aggregate output increases by 2.4%, a larger effect than when I relax the borrowing constraints, which produces an increase in aggregate output of only 1.5%. In both cases, the increase in output is driven by a dramatic increase in productivity.

In the economy with a corporate sector and both financial frictions, the corporate sector employs a significant fraction of labour and capital. When I complete the missing market for risk, the relative value of entrepreneurship, and especially high-risk entrepreneurship, increases. As many individuals switch into entrepreneurship, labour demand rises. As wages rise to clear the labour market, these rising wages crowd out corporate sector employment and so the corporate sector shrinks. It turns out that completing the missing market for risk is so beneficial to the entrepreneurial sector that it entirely crowds out the corporate sector in equilibrium, as can be seen in table 9.[11] The interest rate falls from 4.3% to 3.0%, as the borrowing constraints keep asset demand constrained relative to the equilibrium with the unrestricted corporate sector.

The output gains of completing the missing market for risk are substantially lower in this corporate-sector economy (2.4%) relative to the benchmark economy without a corporate sector (7.7%). Some of this is because the proportion of entrepreneurs expands more, leading to a greater reduction in the aggregate amount of labour supplied. In addition, since the corporate sector has unrestricted access to capital, and entrepreneurs face borrowing constraints, the aggregate stock of capital falls by 10.4%. The extremely large gain in productivity of 27.2%,

[11]Note that this complete crowding out of the corporate sector is only possible because of the assumption that the representative corporate firm has constant returns to scale, as is standard in the literature (Cagetti and De Nardi, 2006). Given the calibrated productivity of the representative corporate sector ($A_C$), the first-order conditions of the corporate firm's problem define a unique relationship between the capital-labour ratio of corporate factor demand and the ratio of the factor prices, but leaves the level of production, and therefore the level of factor demand, undetermined. In the quantitative exercises reported in table 8, there is no ratio of factor prices will both clear the markets and leave the corporate firm with a positive mass of factor demand, resulting in complete crowd-out.

Table 9: Occupational and Risk Choices

| | Percentage of | | Entrepreneurs operating | | Corporate Sector |
|---|---|---|---|---|---|
| | Workers | Entrepreneurs | Low-Risk | High-Risk | Share of Output |
| Corporate Sector Economy | 88.8 | 11.2 | 8.7 | 2.5 | 23.7 |
| Complete Markets | 82.9 | 17.1 | 9.5 | 7.6 | 0.0 |
| Relaxed Borrowing Constraints | 83.2 | 16.8 | 14.0 | 2.8 | 0.0 |

results both because entrepreneurs are operating more high-risk projects, which are more productive on average, and because less capital and labour is distributed across more entrepreneurs facing decreasing returns to scale production functions.

Note that in this economy, completing the missing market for risk substantially increases the mass of individuals operating the high-risk project from 2.5% to 7.6%, but not all entrepreneurs switch to operating the high-risk project. Even though they have access to state-contingent assets, the unsecured borrowing constraint still creates an incentive for some individuals to start the low-risk project.

When I relax borrowing constraints in the corporate sector economy, output increases by 1.5%. Relaxing the borrowing constraints improves the relative value of entrepreneurship for individuals. As more entrepreneurs enter, and existing entrepreneurs invest more, labour demand increases substantially. As wages rise, the entrepreneurial sector crowds out the corporate sector. Again this force is strong enough that the corporate sector is completely crowded out. Despite the relaxation of the entrepreneurial borrowing constraints, the loss of the corporate sector leads to a decline in the aggregate capital stock of 8.8%. Even though entrepreneurs do not face borrowing constraints in terms of capital, the missing market for risk and the unsecured borrowing limit both reduce how much capital the entrepreneurs wish to invest in.

Table 10: Wealth Inequality

| | Wealth Share of Top | | | | |
|---|---|---|---|---|---|
| | 1% | 5% | 10% | 20% | 50% |
| Corporate Sector Economy | 28 | 56 | 68 | 82 | 97 |
| Contingent Claims | 14 | 42 | 60 | 81 | 98 |
| No Borrowing Constraint | 25 | 53 | 63 | 75 | 93 |

Table 10 shows the top wealth shares in the corporate sector economy with and without financial frictions. Like in the benchmark economy, completing the missing market for risk substantially reduces wealth inequality. The wealth share of the top 1% declines from 28% in the economy with both financial frictions to 14% with complete markets for risk. As in section

5, completing the missing market for risk substantially reduces wealth inequality, with the top 1% wealth share falling to 14%. By contrast, relaxing the borrowing constraints in this economy have little impact on the degree of wealth inequality with the top 1% wealth share declining by only 3 percentage points.

# 7 Policy Analysis

The quantitative results in section 5 highlight how important the missing market for entrepreneurial risk is for discouraging entrepreneurial activity. Providing insurance to entrepreneurs may therefore encourage risk-taking. Private markets for this kind of entrepreneurial insurance may be difficult to sustain given the existence of adverse selection and moral hazard problems. However, governments may be able to overcome some of these information problems by virtue of the fact that they can implement policies that include every individual. In the same way that governments provide unemployment insurance for workers, governments may have a unique role to play in providing some partial insurance for unsuccessful entrepreneurs.

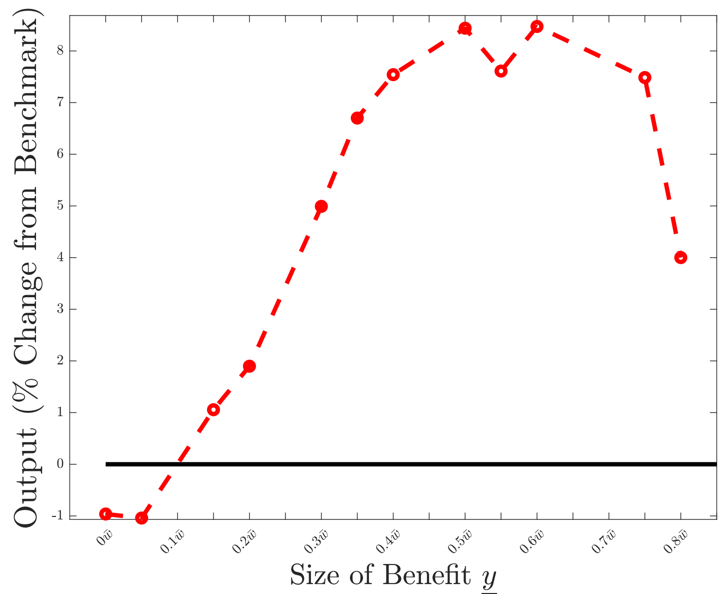
I therefore study a government policy designed to encourage risk taking, without assuming the government can observe the ability of an entrepreneur or the expected productivity of an entrepreneur's project. Specifically, I consider an unemployment-like benefit that tops up the incomes of unsuccessful entrepreneurs. I model this as a transfer that tops up entrepreneurial income to an income floor given by $\underline{y}$. This benefit is paid for with a proportional tax $\tau$ on entrepreneurial income that clears the government's budget constraint. An entrepreneur's income is therefore given by:

$$y = \max\left\{(1-\tau)[(zh^E)^{1-\gamma}(k^\alpha n^{1-\alpha})^\gamma - wn], \underline{y}\right\} \tag{11}$$

Figure 10 plots aggregate output as a function of the size of the unemployment-like benefit for entrepreneurs ($\underline{y}$), expressed as a fraction of the average wage in the benchmark economy ($\bar{w}$). At very low levels of benefit, the policy discourages investment in capital, reducing aggregate output. However, at higher levels of benefit, the policy provides effective insurance. This insurance encourages more entrepreneurs to choose the higher-risk project, as illustrated in figure 11. As the higher-risk project has higher expected productivity, aggregate output increases. At its maximum efficacy, the policy can generate aggregate output 8.5% higher than in the benchmark economy. This is despite the fact that the proportional tax discourages investment in entrepreneurial capital.

The reason why this simple policy is so effective is that it helps alleviate both financial frictions. In the benchmark economy, some high-ability entrepreneurs start high-risk businesses,

Figure 10: Aggregate Output Depending on the Size of Benefit



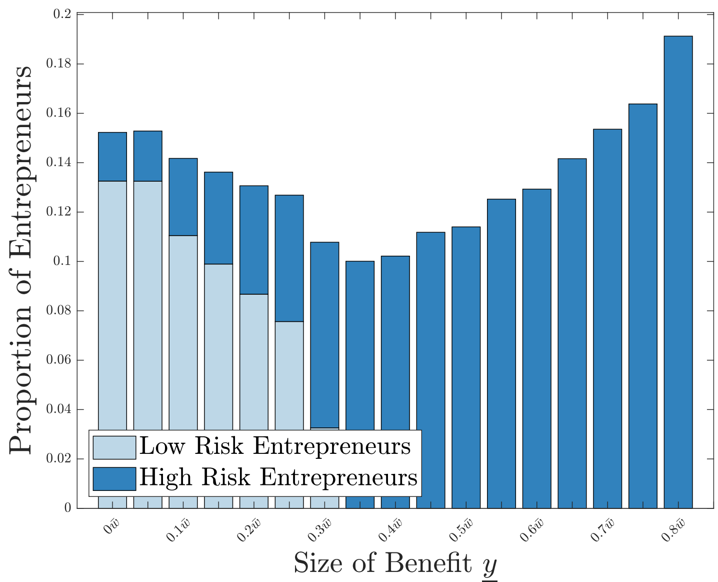

$\underline{y}$ is the income floor given to all unsuccessful entrepreneurs. $\bar{w}$ is the average wage in the benchmark economy without the benefit.

receive bad productivity shocks, and then exit. As they do so, they receive low income for at least one period and also lose a portion of their capital stock as they liquidate their businesses to exit. They exit with lower wealth than they started with and so will be able to invest in less capital if they choose to start another new business. In the economy with the benefit, not only does the benefit provide partial insurance against bad shocks, but it also helps re-capitalize unsuccessful entrepreneurs. In this way, the unemployment-like benefit for entrepreneurs partially alleviates both the missing market for risk and the borrowing constraints.

Of course at the highest levels of benefit, adverse selection becomes a significant problem with this policy. Individuals who have low entrepreneurial ability become entrepreneurs simply because the income floor is higher than what they can earn in the labour market, even if they have no expectation of being able to generate entrepreneurial income. As a consequence, aggregate output begins to fall when the benefit rises too high. As can be seen in figure 10, aggregate output decreases sharply when the benefit exceeds 75% of the benchmark wage, as more and more low-ability individuals select into entrepreneurship. At even higher levels of benefit, so many low-ability individuals select into entrepreneurship that the government is unable to pay for the insurance scheme with any tax rate.

Moral hazard is also present in this policy experiment. Entrepreneurs have weaker incentives to invest in capital if they know that there is some probability that their income will fall below

Figure 11: Proportion of Low-Risk and High-Risk Entrepreneurs




$\underline{y}$ is the income floor given to all unsuccessful entrepreneurs. $\bar{w}$ is the average wage in the benchmark economy without the benefit.

the threshold ($\underline{y}$). Below this level of income, the benefit will increase their income to $\underline{y}$ regardless of how much capital they have invested in. This is why aggregate output declines at very low levels of insurance. At these low levels, the insurance benefit is not large enough to provide effective insurance, but it does discourage capital investment.

This simple insurance scheme is not an optimal policy, but it illustrates that partial insurance schemes can help governments encourage entrepreneurial risk taking, even in a context with both adverse selection and moral hazard. Clearly, the practical design of this type of partial insurance scheme would require careful analysis beyond the scope of this paper, but the quantitative results in section 5 suggest that the potential returns to this type of policy are large.

# 8 Conclusion

This paper studies the quantitative importance of two distinct financial frictions for output, productivity, and wealth inequality. It contributes to a large literature studying how financial frictions distort the decisions of entrepreneurs and how those distortions reduce aggregate output. The key contribution is to study the missing market for entrepreneurial risk, and compares it to the well studied effects of borrowing constraints. I find that the missing market for risk causes larger losses to aggregate output than borrowing constraints and is also a key determinant of top tail wealth inequality.

I present descriptive evidence from the Kauffman Firm Survey that new entrepreneurs face a high degree of idiosyncratic risk, that wealthier entrepreneurs earn more dispersed returns on equity, and that entrepreneurs who invest more of their own money are more likely to raise external funds. Motivated by these facts, I build a model of occupational choice and business risk choice. I calibrate the strength of the two financial frictions in my model to micro data from the Kauffman Firm Survey. In the calibrated model both financial frictions play an important role distorting individuals decisions. I study changes in the patterns of occupational selection, the choice of the riskiness of businesses, and investment when I remove each of the financial frictions. Finally, I study a policy that provides partial insurance to entrepreneurs that encourages them to take more risk, showing that it is successful at increasing aggregate output despite the presence of adverse selection and moral hazard.

Governments around the world seek to balance redistribution with the promotion of entrepreneurship. This paper's results suggest that a promising area is to study the design of partial insurance schemes that encourage more individuals to take the risk of becoming an entrepreneur and encourage entrepreneurs to pursue more innovative business ideas. Not only does this type of policy have the potential to increase economic efficiency, but it also has the potential to reduce wealth inequality.

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# A Stylized Facts Appendix

## A.1 Data Construction

In this subsection, I briefly discuss the choices I made to construct and analyze the KFS data. The Kauffman Firm survey is a panel data set of 4,928 new firms that start in 2004. Given that the data is a survey, sample attrition and non-response is an issue for some observations.

As a result, I drop approximately 10% of the sample firms because they are missing 2 or more observations of either profits or the number of employees in years that they report operating. For some numeric questions, if respondents did not provide an exact amount of the variable in dollars, respondents were asked to provide a range of the amount instead. Throughout this paper, I use the midpoints of these ranges for these observations, as recommended in Farhat and Robb (2014).

The Kauffman Firm survey is a stratified sample based on technology level and gender of owners. All tables, figures, and calibration moments in this paper therefore use the Kauffman Firm survey's provided weights.

## A.2 Measuring Survival

In table 11, I report the current operational status of all firms in the Kauffman Firm Survey over the 8 years of the survey. Firm exit is common. While non-response and sample attrition mean that the status of 701 firms are not available in the final year, 1,901 firms or 45% of the firms with known status have permanently shut down by the end of the sample. An additional 30 were temporarily shut down.

Table 11: Business Status Over Time

| Year | Operating | Shut Down | Merged or Sold | Temp Shut Down | Unknown |
|---|---|---|---|---|---|
| 2004 | 4,928 | 0 | 0 | 0 | 0 |
| 2005 | 3,998 | 260 | 43 | 66 | 561 |
| 2006 | 3,390 | 581 | 90 | 124 | 743 |
| 2007 | 2,915 | 880 | 135 | 98 | 900 |
| 2008 | 2,606 | 1,224 | 175 | 58 | 865 |
| 2009 | 2,408 | 1,474 | 211 | 41 | 794 |
| 2010 | 2,126 | 1,692 | 249 | 45 | 816 |
| 2011 | 2,007 | 1,901 | 289 | 30 | 701 |

Tabulation of the operational status of firms in the Kauffman Firm Survey over the first eight years of operation. Note that when a firm is merged or sold, it exits the sample and so no more information about its operational status is available.

Without observing sale prices or the merger terms, it is impossible to asses whether mergers or sales constitute successful outcomes for entrepreneurs. Throughout this paper, I therefore calculate the survival rate as the number of firms either operating or that have been merged or sold in a previous year, divided by the total number of firms with a known status. As it is likely that some of the firms that were sold or merged were sold for low prices or merged under unfavourable terms for the entrepreneurs, this measure of survival may be an overestimate of successful outcomes. If surveyors have a more difficult time contacting the entrepreneurs of firms who have ceased operations, then this measure of survival is further biased upwards.

### A.3 Calculating Returns on Equity

For each year $t$, I calculate a firm $i$'s return on equity as:

$$\text{Return on Equity}_{i,t} = \frac{\text{Profit}_{i,t}}{\text{Cumulative Equity}_{i,t} + \$68,800 \times \text{Owners Working} \geq 20 \text{ Hours}_{i,t}} \quad (12)$$

where "Cumulative Equity" includes equity invested from both the actively managing entrepreneurs as well as external sources of equity. In order to recognize that the return is not just on the financial investment, I include a term in the denominator designed to capture the sweat equity, or opportunity cost, of the entrepreneur's time. Specifically, I multiply "Owners Working $\geq$20 Hours", the number of owners who are working 20 hours or more in the business, with the average income in the 2004 Survey of Consumer Finances, which is $68,800. Unfortunately, no data is available on the labour market opportunities of these entrepreneurs. Given that some of the businesses have low levels of capital stock, excluding this term leads to extremely high levels of returns on equity.

$\text{Profit}_{i,t}$ is negative in many years for a large fraction of firms. These firms will therefore have negative returns on equity in those years.

How well does this measured return on equity capture the success or failure of these firms? One way to validate this measure is to compare survival rates of firms with different average returns on equity. If the calculated return on equity is a good measure of success, we should expect to see that firms with high average returns on equity are much more likely to survive than firms with low average returns on equity. To do so, I rank firms by their average return on equity and compute the survival probability within each decile of return on equity. For comparison, I do the same thing with the cumulative level of profits.

Table 12 shows that firms that have a low calculate return on equity are very unlikely to still be operating at the end of the eight year sample. Indeed having a low calculated return on equity is a much better predictor of firm exit than have low cumulative profits. However, firms with the highest average returns on equity are slightly less likely to survival than those with the highest levels of cumulative profits.

Table 12: Survival by Cumulative Profits and Average Return on Equity

| | Cumulative Profits | | Average Return on Equity | |
|---|---|---|---|---|
| Decile | Percent of Firms that Survive to Year 8 | Number of Firms | Percent of Firms that Survive to Year 8 | Number of Firms |
| 1 | 36 | 358 | 16 | 319 |
| 2 | 31 | 338 | 36 | 313 |
| 3 | 37 | 372 | 38 | 337 |
| 4 | 38 | 360 | 44 | 334 |
| 5 | 33 | 378 | 41 | 324 |
| 6 | 57 | 410 | 59 | 348 |
| 7 | 59 | 386 | 58 | 317 |
| 8 | 66 | 377 | 67 | 352 |
| 9 | 66 | 386 | 65 | 381 |
| 10 | 74 | 419 | 67 | 376 |

# B Quantitative Robustness Appendix

## B.1 No Endogenous Choice of Risk

In subsection 6.1, I show how completing the missing market for risk impacts aggregate outcomes in an economy without the endogenous choice of risk ($n_x = 1$). In this subsection, I present the calibration of that version of the economy. I recalibrate this one-project model to the same set of moments as the main model in section 4.2. However, given the single project choice, I do not distinguish between high-investment and low-investment firms. Instead, I compute the same statistics for the total population of firms in the Kauffman Firm Survey. Table 13 reports the calibrated parameter values alongside the targeted moments.

Table 13: One-Project Calibration

| Target | Data | Model | Parameter | Value |
|---|---|---|---|---|
| **KFS Moments** | | | | |
| Ratio of Average Debt to Average Equity | 1.2 | 1.5 | $\phi$ | 0.63 |
| 90th percentile of Investment to GDP | 4.9 | 6.2 | $\mu_{z\|x_1}$ | 2.11 |
| Autocorrelation of Employment | 0.61 | 0.81 | $\sigma_{z\|x}$ | 0.50 |
| Survival Rate % | 47 | 50 | $\rho_{z\|x}$ | 0.75 |
| **SCF Moments** | | | | |
| Wealth Ratio of Entrepreneurs to Workers | 7.0 | 6.2 | $\mu_{h^E}$ | -2.89 |
| Wealth Gini | 0.79 | 0.70 | $\rho_{h^E}$ | 0.91 |
| Proportion of Entrepreneurs in Wealthiest 1% | 74 | 89 | $\sigma_{h^E}$ | 1.06 |
| Proportion of Entrepreneurs | 12 | 16 | $\chi$ | 1.12 |

## B.2 Adding a Corporate Sector and Clearing the Asset Market

In subsection 6.2, I add a corporate sector to the economy and also clear the asset market. In this subsection, I present first the equilibrium definition of that version of the economy, and then the details of the calibration.

### Equilibrium Definition

An equilibrium in this version of the economy is a set of value functions $\{V^W, V^{NE}, V^E\}$, occupational choices, a set of policy functions $\{c^W, a'^W, \tilde{a}^{NE}, I^{NE}, x^{NE}, c^E, a'^E, I^E, n^E, N_C, K_C\}$, a distribution of individuals $\{\Gamma^E(a, k, h^W, h^E, z, x), \Gamma^W(a, h^W, h^E)\}$, and prices $\{w, r^a\}$ such that

1. The policy functions solve the individual's problems given by (5), (6) and (7).
2. The policy functions solve the representative corporate firm's problem given by (10).
3. All markets clear:
   - Labour
   $$\int h^w d\Gamma^W(a, h^W, h^E) = \int n^E d\Gamma^E(a, k, h^W, h^E, z, x) + N_C$$
   - Capital
   $$\int a^w d\Gamma^W(a, h^W, h^E) + \int a^E d\Gamma^E(a, k, h^W, h^E, z, x) = K_C$$
   - Final Goods
   $$\int c d\Gamma^W(a, h^W, h^E) + \int (c+I) d\Gamma^E(a, k, h^W, h^E, z, x) = \int \left((zh^E)^{1-\gamma}(k^\alpha n^{1-\alpha})^\gamma\right) d\Gamma^E(a, k, h^W, h^E, z, x) + Y_C$$

   where corporate output $(Y_C)$ is given by:
   $$Y_C = A_C K_C^\alpha N_C^{1-\alpha} \tag{13}$$
4. The distribution of individuals is stationary
$$\Gamma^E(a, k, h^W, h^E, z, x) = \Gamma^{E\prime}(a, k, h^W, h^E, z, x)$$
$$\Gamma^W(a, h^W, h^E) = \Gamma^{W\prime}(a, h^W, h^E)$$

I recalibrate this economy with a corporate sector and with equilibrium in the asset market to the same set of moments as the main model in section 4.2. In addition, I add a single parameter governing the productivity of the corporate sector ($A_C$). I discipline this parameter by targeting the proportion of labour demand that comes from the corporate sector, which Asker et al. (2015) estimate as 31%. Table 14 reports the calibrated parameter values alongside the targeted moments.

Table 14: Corporate Sector Calibration

| Target | Data | Model | Parameter | Value |
|---|---|---|---|---|
| **KFS Moments** | | | | |
| Ratio of Average Debt to Average Equity | 1.2 | 1.0 | $\phi$ | 0.59 |
| Relative Employment (High-to-Low Investment) | 4.0 | 3.2 | $\mu_{z\|x_1}$ | 2.43 |
| 90th percentile of Investment to GDP | 4.9 | 5.1 | $\mu_{z\|x_2}$ | -3.65 |
| Autocorrelation of Employment (Low Investment) | 0.77 | 0.76 | $\sigma_{z\|x_1}$ | 0.21 |
| Autocorrelation of Employment (High Investment) | 0.79 | 0.60 | $\sigma_{z\|x_2}$ | 5.55 |
| Survival Rate % (Low Investment) | 47 | 29 | $\rho_{z\|x_1}$ | 0.58 |
| Survival Rate % (High Investment) | 55 | 48 | $\rho_{z\|x_2}$ | 0.94 |
| **SCF Moments** | | | | |
| Wealth Ratio of Entrepreneurs to Workers | 7.0 | 7.1 | $\mu_{h^E}$ | -2.31 |
| Top 1% Wealth Share | 34 | 28 | $\rho_{h^E}$ | 0.91 |
| Proportion of Entrepreneurs in Wealthiest 1% | 74 | 63 | $\sigma_{h^E}$ | 1.98 |
| Proportion of Entrepreneurs | 12 | 11 | $\chi$ | 1.11 |
| **Other Moments** | | | | |
| Public Firm Employment Share | 31 | 26 | $A_C$ | 0.76 |