Entrepreneurial Risk and Market Entry

A Working Paper

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Note

This paper was the recipient of the 2005 Office of Advocacy Best Doctoral Paper Award at the United States Association for Small Business and Entrepreneurship (USASBE) annual meetings. Xun (Brian) Wu is a doctoral student at the Wharton School at the University of Pennsylvania. Anne Marie Knott is a visiting assistant professor at the Robert H. Smith School of Business at the University of Maryland at College Park.

Purpose

Entrepreneurs, by their nature, are risk takers. The authors of this study suggest that there are two forms of uncertainty in entrepreneurial ventures: (1) uncertainty regarding market demand, and (2) uncertainty regarding one's own entrepreneurial ability. They further propose that entrepreneurs display risk aversion with respect to demand uncertainty, but exhibit overconfidence or "risk seeking" with respect to ability uncertainty. To examine this view, the authors model the entrepreneur's entry decision.

Overall Findings

The research shows that entrepreneurs, while risk-averse in their role as risk-bearers, are willing to bear economic risk when overconfidence compensates for their aversion

Highlights

Using data from the banking industry, the authors confirm their hypothesis. Entrepreneurs are risk-averse towards market demand but are overconfident with respect to their own abilities. These results reconcile entrepreneurial risk aversion with their role as economic risk bearers. Entrepreneurs are willing to bear economic risk when the degree of ability uncertainty is comparable to the degree of demand uncertainty.

Scope and Methodology

To test the entry decision, the authors have chosen the post-deregulation commercial banking industry. This industry is ideal because it is fragmented with localized competition, is marked by significant de novo entry, and because the Federal Deposit Insurance Corporation (FDIC) collects complete cost data on all firms.

The data for this study come from the FDIC Research Database, which contains quarterly financial data for all commercial banks filing the "Report of Condition and Income" (Call Report). Each of the 50 states and the District of Columbia is examined for the period 1984 to 1997.

There are two stages to the analysis. In the first stage, the authors model an industry cost frontier to collect measures of cost efficiency for each banking firm in each year. In the second stage, entry is modeled as a function of the two sources of uncertainty: demand and ability.

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Entrepreneurial Risk and Market Entry

Abstract

This paper attempts to reconcile the risk-bearing characterization of entrepreneurs with the stylized fact that entrepreneurs exhibit conventional risk aversion profiles. We propose that the disparity arises from confounding two distinct dimensions of uncertainty: demand uncertainty and ability uncertainty. We further propose that entrepreneurs will be risk averse with respect to demand uncertainty, yet "risk-seeking" (or overconfident) with respect to ability uncertainty. To examine this view we model the entrepreneur's entry decision then test the model empirically. We find that entrepreneurs in aggregate behave as we predict. Accordingly, risk-averse entrepreneurs are willing to bear market risk when the degree of ability uncertainty is comparable to the degree of demand uncertainty. A potential market failure exists however in instances where there is a high degree of demand uncertainty, but low ability uncertainty. In those settings there may be insufficient entry, competition and innovation.

1. Introduction

A long history of entrepreneurship literature has asserted that a critical economic role of the entrepreneur is risk-bearing. One consequence of that perspective is that the theoretical and practitioner literature has assumed that entrepreneurs are risk-seeking. To date however, the empirical literature has consistently found that entrepreneurs' risk profiles seem to be indistinguishable from those of wage earners.

We believe that the disparity between intuition/theory and the stylized facts lies in the dimensionality of uncertainty. In particular, we propose that there are two distinct sources of uncertainty in entrepreneurial ventures: 1) uncertainty regarding market demand, and 2) uncertainty regarding one's own entrepreneurial ability. We further propose that entrepreneurs display risk aversion with respect to demand uncertainty, but exhibit overconfidence or "risk seeking" with respect to ability uncertainty. Accordingly while entrepreneurs are risk-averse in the classic sense of preferring a certain payment to an uncertain payment with equivalent expected value, their overconfidence predisposes them to bear economic risk under a given set of circumstances. The distinction is important because there is no reason to believe a priori that the two forms of uncertainty are correlated. Accordingly there may be settings where it is not possible to find entrepreneurs to perform the risk-bearing role. In those settings, there may be insufficient entry, competition and innovation.

If entrepreneurs and incumbents are perfect substitutes, and if incumbents (as institutions) are risk neutral or can pool their risk, lack of entry by de novo firms may not be an issue. However, there is increasing evidence that large firms and small firms behave differently. In particular, large firms are more likely to employ generalist strategies, thus they may leave portions of the markets underserved. Second, large firms and small firms engage in different types of innovation. Small firms are more likely to engage in more radical innovation, while large firms engage in incremental innovation (Acs and Audretsch 1988, Rosen 1991). Third, even when large firms do innovate, often they abandon the innovations because initial market forecasts don't satisfy size or fit criteria (Hellmann 2002, Chesbrough and Rosenbloom 2002). Thus the absence of de novo entry by entrepreneurs has potential welfare and growth consequences.

Both dimensions of uncertainty have been proposed previously. Indeed, March and Shapira (1987) actually draw the contrast between "managerial gambling" (undertaking exogenous risks) and "risk taking" (undertaking risks over which managers believe they have some control). The contribution of this paper is to consider the two dimensions jointly in modeling and testing entrepreneurs' entry behavior. To conduct the empirical test, we characterize both dimensions of uncertainty across a set of equivalent markets over time, then estimate the degree to which aggregate de novo entry responds to each dimension. Accordingly, we examine whether entrepreneurs in aggregate exhibit decision biases. We do not assess whether their biases (if any) differ from those of wage earners. Finally we draw inferences for the risk-bearing role of the entrepreneur.

2. Entrepreneurship and Demand Uncertainty

A fairly well-established theme in the entrepreneurial literature is that a key economic role of entrepreneurs is risk-bearing. This view dates back to Cantillon (1755) who characterized the economy as consisting of two classes of inhabitants (aside from the Prince and Landowners): "hired people" on fixed wages, and "undertakers" who purchase inputs (including labor) at fixed prices without assurance of profits. The key distinguishing feature of the second class is that it *undertakes* the risk of demand and price uncertainty (which at the time of his writing must have been quite high because one of the factors Cantillon considered was the number of deaths of local inhabitants). Included in the undertaker (entrepreneur) class were farmers, merchants, shopkeepers and master craftsmen (even robbers).

This view was expounded by Knight (1921), and in fact the view of entrepreneur as risk-taker is probably most associated with Knight. Knight's contribution was to draw a distinction between *risk*, which involves recurring events whose relative frequency can be known from past experience, and *uncertainty*, arising from unique events which can only be subjectively estimated. Risk is considered to be a relatively insignificant problem in that it can be accommodated through pooling and insurance. Uncertainty in contrast requires an economic functionary, the entrepreneur, whose job it is to decide what to do and how to do it in the face of uncertainties. Knight proposed that there is diversity among individuals with regard to confidence in one's judgment and the disposition to act on those judgments. Those who are "confident and venturesome 'assume the risk' or 'insure' the doubtful and timid by guaranteeing to the latter a specified income in return for an assignment of the actual results."(Knight 1921: III.IX.10).

Anticipating later work by Camerer and Lovallo (1999), Knight asserts that "If men are poor judges of their own powers as well as ignorant of those other (entrepreneurs), the size of the profit share depends on whether they tend on the whole to overestimate or underestimate the prospects of business operations" (III.IX.34).

The risk-bearing theme has been carried forward into the theoretical and empirical literatures on self-employment, and the managerial literature on entrepreneurial personality.

Indeed entrepreneurs do bear greater risk than wage earners. First they bear income risk in that the stream of income from new ventures is uncertain. In the worst case the firm fails and the income stream ceases. This risk of failure is considerable. Approximately 10% of all firms in the United States fail each year (U.S. Small Business Administration 1999). Moreover most of this failure is drawn from new firms. Dunne, Roberts and Samuelson (1988) found that 61% of manufacturing plants exited within their first five years. The exit rates within the first ten and fifteen years were 78% and 88%, respectively. Thus the probability that a manufacturing venture will be viable over the long run appears to be less than 15%. An additional but related risk pertains to invested capital. While shareholders can minimize risk by diversifying their holdings precisely as Knight suggests, entrepreneurs typically must invest the bulk of their wealth in a single asset - the venture.

Given that entrepreneurs perform a risk-bearing role, most theoretical literature has assumed that entrepreneurs have greater risk-tolerance than wage earners (McClelland 1961, Lucas 1978, Kanbur 1979, Kihlstrom and Laffont 1979). An empirical literature has emerged to test this inference. The surprising result has been that entrepreneurs don't appear to differ from wage earners on this trait. In fact, where there are differences they tend to indicate that entrepreneurs exhibit greater risk aversion than wage earners (Brockhaus 1980, Masters and Meier 1988, Miner and Raju 2004).

One of the reasons that studies may fail to find risk tolerance is that the instruments used to test risk vary across studies, and each instrument operationalizes risk quite differently. Brockhaus (1980) and Masters and Meier (1988) use a Kogan-Wallach Choice Dilemma Questionnaire (CDQ) which asks respondents to report what success threshold a given action would require before they would recommend it to someone seeking advice. Both studies found no significant difference between entrepreneurs and managers on the recommended thresholds. Of course one possible reason for this result is that people may be willing to undertake risk themselves while not recommending it for others. However, results from twelve studies using a different instrument, the Miner Sentence Completion Scale (MSCS), all found entrepreneurs to be risk-avoiding relative to managers (Miner and Raju 2004). Another study, Sarasvathy, Simon and Lave (1998) found that entrepreneurs are risk averse relative to bankers in that they trade higher expected value projects for ones with narrower variance (particularly avoiding negative outcomes).

Results from economic tests are similarly equivocal. Cramer, Hartog, Jonker, and van Praag (2002) compare individuals' valuations for a lottery ticket and find that subjects who had ever been self-employed exhibited greater risk tolerance than wage earners even after controlling for wealth effects (the self-employed tend to have greater wealth and therefore bear less relative risk than wage earners). In contrast, Mazzeo (2004) compares an individual entrepreneur's choice between operating an independent establishment (sole ownership) and becoming a franchisee (sharing risk with the franchisor) in the same market. He finds that franchising increases with the degree of uncertainty in the underlying economic environment, thus suggesting risk aversion.

In summary, while there is some evidence to the contrary, the weight of the empirical evidence tends to indicate that entrepreneurs have comparable risk profiles to those of wage earners. This leaves the question of what accounts for their willingness to bear risk. We believe the answer to that question lies in the second dimension of uncertainty.

3. Entrepreneurship and Ability Uncertainty

While the most prevalent view of entrepreneurial risk pertains to classic risk aversion, in that an individual is more interested in a certain payoff than in an equivalent expected value from an uncertain payoff, a second view emerges from the work of Knight (1921), Kanbur (1979), Jovanovic (1982), Lippman and Rumelt (1982), March and Shapira (1987), Camerer and Lovallo (1999), and Norton and Moore (2002). In this view a critical source of economic uncertainty pertains to entrepreneurial ability. Entrepreneurs know for example, the distribution of firms' cost within the market, but are uncertain about where they lie in that distribution. Ability uncertainty has two potential effects on entry: a rational options effect and an overconfidence effect. We discuss each of these in turn.

High degrees of ability uncertainty will lead to apparent risk-seeking even if entrepreneurs are rational and risk-neutral (Lippman and Rumelt 1982). This occurs because entrepreneurial ventures have an options structure. The upside returns are uncertain, but the downside risk is limited by the entry fee. Accordingly greater dispersion in profits leads to higher expected values net of the entry fee. If entrepreneurs base decisions on net present values, risk-neutral entrepreneurs will appear to be risk-seeking in that they will rationally prefer more uncertain distributions.

A more provocative view finds that under certain circumstances, entrepreneurs exhibit true "risk-seeking" with respect to ability uncertainty. This arises from overestimating their capability. In this view entrepreneurs know the ability distribution and the associated expected value of entry, but they believe that their own ability is drawn from a narrower and biased distribution (March and Shapira 1987, Busenitz 1999, Camerer and Lovallo 1999, Norton and Moore 2002). Indeed this tendency was anticipated by Knight's insight that the distinguishing feature of entrepreneurs is their level of confidence in being able to handle unforeseeable events. Accordingly, it is not that entrepreneurs have greater risk tolerance, it is they don't view the business situations as being risky (March and Shapira 1987, Palick and Bagby 1995, Sarasvathy, Simon and Lave 1999). Instead they believe that through skill and information they can condition the odds they face.

Jointly considering the two types of uncertainty: demand uncertainty and ability uncertainty, sheds new light on entrepreneurial risk and behavior. Entrepreneurs should exhibit risk aversion with respect to demand uncertainty, but exhibit "risk seeking" (overconfidence) with respect to ability uncertainty. If so, then they will be willing to bear economic risk in a given market so long as there is sufficient ability uncertainty.

4. A Model of Entry

We clarify the distinction between the two types of risk through a model of the entrepreneur's entry decision. This model allows us to examine aggregate entry in response to changes in market conditions, but does not allow us to identify who in a risk set will make the transition from wage employment to self-employment. Following the self-employment literature, we model an individual's choice between the expected value of entrepreneurial profits, Π, and that of wage income, W, given uncertainty about own cost.

4.1 Risk Neutrality

We begin with a model of risk-neutral behavior. The functional form for profits, Π, follows Lippman and Rumelt (1982):

$$E(\Pi) = -K + \frac{1}{r}\int_{0}^{c_0} q(p-c)dF(c) \qquad (1)$$

where:

q	is firm output
p	is market price
K	is the investment required to produce quantity q
r	is the discount rate.
c	is the firm's cost, drawn from distribution F
c_0	is the largest solution to $p\text{-}c = 0$

Prospective entrepreneurs compare the expected profit from their proposed venture to the alternative income stream from wage employment. Entry occurs when the expected profit stream exceeds the entrepreneur's opportunity cost (fixed fee plus the wage stream from the best employment alternative):

$$\int_{0}^{c_0} q(p-c)dF(c) \; > r\,(W + K) \qquad (2)$$

We assume that $F(c)$ is normally distributed, and thus can be fully characterized by its mean, μ, and dispersion, σ[1] Accordingly we can write a simple expression for the expected value of annual profits, $E(\Pi)_t$, given the mean cost, μ_s, of surviving firms (those for whom $c \leq c_0$), and the failure rate, λ, representing the entrepreneur's ex ante probability of drawing a value for $c > c_0$. This expression characterizes the truncated distribution of long-run profits, where firms who are forced to exit ($c > c_0$) obtain zero long run profits, and surviving firms ($c \leq c_0$) obtain $q(p\text{-}c)$ in perpetuity.

$$\begin{aligned} E(\Pi)_t &= \lambda *0 + (1 - \lambda)*q(p\text{-}\mu_s) \qquad (3) \\ &= qp - \lambda qp - q\mu_s + \lambda * q\mu_s \end{aligned}$$

Equation 3 captures the options structure of payoffs through the failure rate, λ, and the mean cost of surviving firms, μ_s. This allows us to use dispersion in ex ante cost, σ, net of the options effects, to capture overconfidence. Accordingly we can distinguish between the two factors (options payoffs and overconfidence) that produce "apparent risk-seeking". Replacing the expression for the left hand side of equation 2, yields the following entrepreneurial decision rule:

$$p(Entry) = Pr[qp - \lambda qp - q\mu_s + \lambda * q\mu_s - r\,(W + K) > 0] \qquad (4)$$

[1] This assumption holds true in our empirical setting

Equation 4 captures individual propensity to enter, *p(Entry)*. To examine entry in market *j*, we want to aggregate individual propensity in equation 4 over the pool of prospective entrants, n_j. The pool includes those with relevant industry experience together with sufficient wealth to cover the entry cost, K:

$$Entry_j = p(Entry)*n_j = Pr[qp - \lambda qp - q\mu_s + \lambda * q\mu_s - r\,(W + K) > 0] * n_j \quad (5)$$

To consider economic risk we further assume that *r* is decomposed into a risk-free component, r_f, and a risk premium, r_m, reflecting market volatility. Note that if entrepreneurs are risk-neutral, there should be no risk premium. Equation 5 together with the decomposition generates the following propositions regarding a rational and risk-neutral entrepreneur:

1) Entry is decreasing in the failure rate, λ
2) Entry is decreasing in the mean survivor cost, μ_s
3) Entry is increasing in cross-term, $\lambda * \mu_s$.
4) Entry is decreasing in opportunity cost ($W + K$)

5a) Entry is insensitive to dispersion of the ability distribution, σ.[2]

6a) Entry is insensitive to market volatility, $r_m(RMSE)=0$

4.2 Risk Aversion and Overconfidence

If however entrepreneurs' decisions are biased in the manner discussed previously: risk averse with respect to market uncertainty and overconfident with respect to ability uncertainty, we replace propositions 5a and 6a as follows:

5b) Entry is increasing in dispersion of the ability distribution, σ(overconfidence)

6b) Entry is decreasing with market volatility $r_m(RMSE)$ (risk aversion)

5. Empirical Approach

5.1 Industry

In order to test the propositions we need a setting that 1) allows us to characterize the cost distribution over the full set of firms, 2) has substantial entry and provides reliable counts of that entry for firms of all sizes, and 3) comprises a large number of comparable markets that share common technology and common demand functions. We could find only one such industry —commercial banking post de-regulation. The banking industry is ideal because it is fragmented with localized

[2] Note that σ pertains to the ex ante distribution of cost functions rather than to the truncated distribution of survivors

competition, is marked by significant de novo entry, and because the FDIC collects complete cost data on all firms. Fragmentation allows us to compare discrete markets with a common inverse demand function and common technology. Thus we can compare the changes in market conditions (demand volatility and cost heterogeneity) while controlling for other factors that differ across industries[3]. We can also control for differences in the level of demand through differences in economic conditions across markets.

In addition to the quasi-experimental advantages of banking for our purposes, banking is one of the most important industries in the economy. Financial services' output is roughly $2.1 trillion (20% of GDP). Furthermore, even though the banking is one of the oldest industries, it has been growing at 6.5% rate over the past ten years (roughly three times GDP growth). Accordingly a study of entry in banking is potentially important in its own right.

5.2. De Novo Entry in Banking

There is substantial entry in the banking industry over the period we examine (1984-1997). Figure 1 indicates there are two waves. The first wave corresponds to de-regulation. The second wave corresponds to changes in the laws governing interstate branching. In both regimes the dominant mode of entry is de novo startups by entrepreneurs (94.3% of new charters), rather than expansion of existing bank holding companies.

Insert Figure 1 about here

An interesting question is why there is any denovo entry in an industry that is otherwise experiencing dramatic consolidation. Interviews with industry experts reveal that consolidation is actually provides the *impetus* for entry. Merger activity has three effects. First, it creates the "market void" that is required for approval of a new charter. The particular void is typically small business lending (Goldberg and White 1998). Second, mergers creates "liquidity events" (Stuart and Sorenson 2003), wherein displaced bank executives are both in search of new employment and flush with proceeds from the merger[4]. This displacement would appear as a supply shock in equation 4, in that *W* drops to

[3] All results have been replicated in a cross-industry study, thus they appear to be robust across a range of settings. Those results are of limited value theoretically however because there is no means to address endogeneity concerns that technology differences drive both entry and cost heterogeneity.

[4] The gains from liquidated ventures raise the issue of a "house money effect" (Thaler and Johnson 1990) wherein prior

zero. The experience of these displaced executives and their financial assets supply the two other main criteria required for charter approval. Third, the expectation of future mergers provides a liquidation mechanism for the startup banks, similar to the liquidation mechanism sought by venture capitalists in the high-tech sectors. This liquidation potential appears as a demand shock in equation 4 in that the expected returns include an acquisition premium above and beyond the present value of the remaining profit stream.

5.3. Empirical Model

The empirical approach we take in this paper is to compare aggregate entry across markets in order to characterize entrepreneurs' behavior along each dimension of uncertainty. This allows us to examine if "risk-seeking" (overconfidence) with respect to ability uncertainty is able to compensate for risk aversion with respect to demand uncertainty. If so, then risk averse entrepreneurs are willing to bear economic risk in certain markets. Note that our approach examines aggregate behavior in each market, thus it ignores characteristics of individual entrepreneurs. Accordingly we are unable to answer the question of whether entrepreneurs have different risk profiles than wage earners. We can only answer the question of whether entrepreneurs on average appear to be risk-averse and/or overconfident.

Analysis of equation 4 proceeds in two stages. In the first stage we model an industry cost frontier to collect measures of cost efficiency for each firm in each year. This allows us to characterize μ_s and σ for each market in each year. In the second stage, we model entry as a function of the two sources of uncertainty: demand uncertainty and ability (cost) uncertainty.

Stage 1-Characterizing Firm Cost Efficiency. We follow convention in studies of bank efficiency by modeling a stochastic cost frontier using a translog cost function (Cebenoyan, Papaioannou and Travlos 1992, Hermalin and Wallace 1994, Berger, Hancock and Humphrey 1993, Mester 1993). Stochastic frontier analysis, developed by Aigner, Lovell and Schmidt (1977), is based on the econometric specification of a cost frontier. The stochastic frontier model assumes that the log of firm *i*'s cost in year t, c_{it}, differs from the cost frontier, c^{min}, by an amount that consists of two distinct components: a standard normally distributed error term e_{it}, and a cost inefficiency term modeled as a non-negative random variable u_{it} – which we assume to take the form of a truncated

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gains lead to risk-taking behavior. To date this effect has been examined in the context of pure gambles rather than contests of skill. Though a similar effect surfaces in the Camerer and Lovallo experiment, where confidence of players increases as they progress through a tournament, despite the fact that the expected skill of players they will be facing is increasing across rounds. Accordingly we would expect liquidation events to increase risk-taking along both dimensions of uncertainty. Without controls for these events, results will understate the level of risk aversion along both dimensions.

normal distribution.[5]

We use the translog cost function to accommodate the complex array of bank inputs and outputs. In addition, the translog form accommodates tradeoffs in both market strategies (product mixes and prices), and operational strategies (input mixes). The basic translog cost function models a cost minimizing firm i in year t operating with (in log form) outputs y_{it} and with input prices w_{it} , where the operational definition of a firm is a bank certificate as described in section 5.1:

$$c_{it} = \beta_0 + \sum_j \beta_{1j} y_{it}^j + \sum_k \beta_{2k} w_{it}^k + \tfrac{1}{2} \sum_j \sum_j \beta_{3jj} y_{it}^j y_{it}^j + \\ + \tfrac{1}{2} \sum_k \sum_k \beta_{4kk} w_{it}^k w_{it}^k + \sum_j \sum_k \beta_{5jk} y_{it}^j w_{it}^k + u_{it} + e_{it} \qquad (6)$$

where:

c_{it} = log observed firm cost

y_{it}^j = vector of log output levels - j indexes output elements

w_{it}^k = vector of log input prices - k indexes input elements

u_{it} = cost inefficiency with truncated normal distribution

e_{it} = error term with normal distribution.

We pool data for all firms over fourteen years using the stochastic frontier model to capture firm-year measures of cost inefficiency relative to a global cost frontier. We collect the estimates of the expected value of firm-year cost inefficiency in stage 1, $E(u_{it} | e_{it})$, which for convenience we continue to label as u_{it}, and use the estimates to form the cost distribution for each market in each year.[6]

Stage 2 – Test of Propositions**.** To test the propositions derived from equation 5 we need to make assumptions about how entrepreneurs assess market volatility, r_{jt}, the ex ante cost distribution, μ_{jt} and σ_{jt}, and the failure rate, λ_{jt} in their respective markets, j. Our measure of market volatility follows the conventional approach (Mazzeo 2004, Norton 1988) where risk is approximated by variability in demand. Market volatility is measured as the root mean squared error (RMSE) from

[5] Other distributional assumptions are also possible, the most common of which are the half normal and exponential distributions. All results are robust to these alternative distributions.

[6] In the second stage we use the natural log of u_{it} to construct a measure that is normally distributed.

the regression *ln(market demand)* = $\alpha_0 + \alpha_1$*(trend) over a moving ten year window. We also capture the trend itself as a control variable reflecting market opportunity.

A central issue in characterizing the cost distribution is the relevant set of incumbents assessed by potential entrants. There are two logical candidates. The first is members of bank holding companies (the larger firms engaged in the merger activity), and the second is independent banks. We characterize the cost distributions for each group in each market year, and then test them separately. We construct two measures of the cost distribution for each group in each market year: μ_{sjt} and σ_{jt}, where the set of survivor firms is defined as those who have remained in the industry for three years. We use three years as the cutoff because 70% of firms who will ultimately exit the industry do so by year three, but results are robust to alternative age thresholds.

The third measure entrepreneurs use to make their decision is the failure rate, λ_{jt}. We measure failure as the ratio of the number of failures over the number of incumbents, where failure is defined as the sum of forced mergers and FDIC "paid outs". Forced mergers between a failed institution and a healthier bank are the dominant form of FDIC resolution. The less common resolution is "paid outs", where the FDIC pays depositors for their lost deposits under FDIC insurance provisions. A third mechanism of bank exit is a voluntary merger with an existing bank. For completeness we also construct a measure of the voluntary merger rate. The theoretical and empirical discussion in section 5.2 suggests that mergers stimulate denovo entry. We therefore expect the merger rate to have a positive effect on entry, whereas proposition 1 anticipates the failure rate (paid-outs and forced mergers) to have a negative effect on entry.

The final element in equation 4 is opportunity cost. We capture K_{jt} through market indices of real estate prices. We capture W_{jt} through average annual income in the market. Both indices are market-year specific.

One issue with respect to the full set of independent variables is the appropriate lag between observation of market conditions by the prospective entrepreneur, and the actual entry. This lag will depend upon the length of the set-up process. Discussions with an industry expert indicate that the setup process is typically eighteen months. Rather than imposing this lag, we tested lags of one to five years for the full set of explanatory variables.

We model entry rate (with entry counts on the left hand side and the number of incumbents on the right hand side[7]) as a function of the two types of uncertainty, the failure rate, and opportunity cost, controlling for time-varying market factors as well as market fixed effects and industry-wide year effects:

$$entry_{jt} = \beta_0 + \beta_1 * incum_{jt-1} + \beta_2 * \lambda_{jt-1} + \beta_3 * \mu_{sjt-1} + \beta_4 * \sigma_{jt-1} + \beta_5 * (\lambda_{jt-1} * \mu_{sjt-1}) + \beta_6 * growth + \beta_7 * RMSE_{jt-1} + \beta_8 W_{jt-1} + \beta_9 K_{jt-1} + \delta_t + \gamma_j + e_{jt} \quad (7)$$

If entrepreneurs are rational, we expect β_2, β_5, β_8 and β_9 to be negative, and β_3 to be positive (propositions 1-4). If in addition they are risk neutral we expect β_4 and β_7 to be insignificant (propositions 5a and 6a). If however, entrepreneurs are biased in the manner discussed previously, then they are risk averse with respect to demand uncertainty and β_7 should be negative (proposition 6b); and they are overconfident with respect to cost uncertainty and β_4 should be positive (proposition 5b). Note the coefficient β_4 captures the effects of cost uncertainty above and beyond those associated with the options structure of entrepreneurial returns. These options effects, derived in equation 3, are captured by β_2 and β_5.

Estimation of equation 7 requires count data models, since the dependent variable, the number of entries in a market-year, is a non-negative integer. Given that, the use of OLS violates the assumptions of homoskedasticity and normality (Greene 1997). Accordingly we employ a fixed effects negative binomial model (Cameron and Trivedi 1998, Greene 1997).

5.4 Data

The data for the study comes from the FDIC Research Database which contains quarterly financial data for all commercial banks filing the “Report of Condition and Income” (Call Report). We examine each of the fifty states plus the District of Columbia for the period 1984 to 1997. This initial data set contains 694,587 firm-quarter observations. Following convention in the banking literature we aggregate to annual data by averaging the quarterly data (Mester 1993). The final first stage data set comprises 170,859 firm-year observations.

While there is considerable debate as to the choice of inputs and outputs in the banking sector, a review of the literature suggests that there is some convergence around a model that sees capital and labor as inputs to the production process and various forms of loans as outputs (Wheelock & Wilson, 1995). We collect data to construct seven variables related to banking efficiency in log thousands of constant 1996 dollars. The dependent variable is total cost – total interest and non-interest expenses.

[7] The inclusion of the number of incumbents also controls for the effects of market size.

The six independent variables are divided between input prices and output quantities. Input prices are: (a) labor price – salary divided by the number of full time equivalent employees; (b) physical capital price – occupancy and other non-interest expenses divided by the value of physical premises and equipment; (c) capital price– total interest expense divided by the sum of total deposits, other borrowed funds, subordinated notes and other liabilities. Output quantities are stocks of: (d) mortgage loans; (e) non-mortgage loans; and (f) investment securities.

Our operational definition of a market in the analysis is a state. In part this definition arises from a data limitation. The unit of observation in the FDIC data is an insurance certificate, which is the unique number assigned to a bank upon entry into a given state. A separate certificate is required for each state in which a bank operates[8], but covers all branches for that bank operating within the state. Ignoring for a moment the data limitation, there are two discrete definitions of market: the state, representing certificate/headquarters level competition, or municipality, representing branch level competition. A reasonable argument for not doing branch level analysis, even if data were available, is that it is difficult to determine a relevant radius for competition. Consumers might choose a branch close to their home or one close to their office, but they may also choose a bank based on the fact that it had branches near both, suggesting aggregation to a metropolitan area. Continuing that logic a state is merely further aggregation, representing on average 7.1 Metropolitan Statistical Areas (MSA), 1.3 Primary Metropolitan Statistical Areas (PMSA) or 0.4 Consolidated Metropolitan Statistical Areas (CMSA). Given the difficulty choosing a level of aggregation for branch level competition, and given the fact that the state captures headquarters competition, we define a market as a state.[9]

In order to test the entry decision, we gather aggregate state-year data on entry from the FDIC database. We define entry as a new commercial banking institution that comes into existence by way of a new charter. This definition restricts the sample to de novo entry by entrepreneurs, i.e., it excludes the addition of new banks to existing bank holding companies. It is interesting to note that such de novo entry comprises 94.3% of all entry in banking over the period we examine. Table 1

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[8] Interstate branching was expressly forbidden prior to June 1997 unless state legislation expressly approved it. The first state to allow interstate branching was New York in 1992, under conditions of reciprocity. As of 1993 only four states allowed interstate branching. Results are robust to excluding data post 1993.

[9] As an additional test of reasonableness, Petersen and Rajan (2002) examine the distance between small firms and the bank branch they use most frequently. They find that the distance capturing 75% of firms in 1990-1993 is 68 miles, and growing rapidly due to information technology. This implies a circumscribed area of 14524 miles, which is greater than the land area of 10 states, and equal to 26.3% of the mean land area of all states excluding Texas and Alaska.

provides variable descriptions and summary statistics of the data used in Stage 1.

Insert Table 1 about here

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6. Results

Stage 1 – Characterizing Firm Cost Efficiency**.** We estimate the stage 1 stochastic frontier model assuming a truncated normal distribution for the inefficiency term and a normally distributed error term. As mentioned previously, results are robust to alternative specifications for the inefficiency term. Results from the stage 1 analysis using equation 6 are given in Table 2.

The most important result of the stage 1 frontier estimation is the value of the inefficiency terms, u_{it}. The distribution of firm cost inefficiency over all market-years is given in Figure 2, and the mean value over time is depicted in Figure 3. The mean u_{it} over the entire period is 0.171, which indicates that the mean firm has cost 18.6% above that of a firm on the cost frontier. The data also indicate that while the mean cost inefficiency changes over time in response to changing technologies and demand conditions, the general trend, particularly over the mid 1990s, is toward increasing efficiency (decreasing cost). This is consistent with prior studies of the industry.

While a discussion of the estimated coefficients of the frontier model is outside of the scope of this paper, the coefficient estimates are consistent with expectations as: (a) total costs appear to rise with output and increases in the price of capital, and (b) firms substitute labor and physical capital in response to changing prices for these inputs. These results reinforce confidence in the frontier technique.

Insert Table 2 about here

Insert Figures 2 and 3 about here

Stage 2 – Test of propositions. Cost efficiencies from stage 1 were used to create estimates of the cost distribution for each market, j, in each year, t. We characterized each ex ante cost distribution by its mean value, μ_{jt}, and dispersion σ_{jt}. We also characterized the mean of the survivor populations, μ_{sjt}.[10] These estimates were combined with measures for market volatility, $RMSE_{jt}$, the failure rate, λ_{jt}, and opportunity cost, W_{jt} and K_{jt} to test the propositions derived from equation 5. Summaries of these measures are provided in Table 3.

Insert Table 3 about here

Table 4 presents the results for the test of equation 7. Model 1 is a simple model of controls for market opportunity; model 2 is the baseline model of rational entry given an options structure for entrepreneurial returns (testing propositions 1-4); model 3 adds terms for both dimensions of uncertainty to test propositions 5 and 6.

Insert Table 4 about here

Results for model 1 indicate that entry responds to conventional measures of market opportunity. Denovo entry increases with demand growth and decreases with the number of incumbents and the degree of market concentration.

Adding terms for the options payoff structure captured in equation 4 (Model 2), indicates that entry behavior is rational. Entry is decreasing in the failure rate, λ_{jt} (proposition 1) and mean survivor cost, μ_{sjt} (proposition 2), and is increasing in the cross-term, $\lambda_{jt}*\mu_{sjt}$ (proposition 3). All results are as expected. In addition, we included a control for voluntary mergers based on the discussion of liquidation effects in section 5.2 suggesting that merger activity should be treated separately from failure. The coefficient on mergers is positive and significant at the 10% level, providing weak support for liquidation effects. We cannot however distinguish between supply shock effect of the merger (displaced bank executives with eased liquidity constraints for whom W has dropped to 0) and the demand shock effect of future expectation of an acquisition premium.

Model 3 is our main test. It examines entrepreneurial behavior along both dimensions of uncertainty. Results indicate that entry is increasing with cost uncertainty, σ_{jt} (proposition 5b), and decreasing with market volatility, $RMSE_{jt}$ (proposition 6b). Accordingly entrepreneurs in aggregate

[10] Our baseline model uses the set of independent banks to construct the cost distribution measures. However we separately examine the cost distribution of bank holding companies.

appear to be "risk-seeking" or overconfident with respect to ability uncertainty, while risk averse with respect to demand uncertainty. Again, these results are as expected.

Model 4 adds a simple test comparing two alternative reference sets that entrepreneurs could use to estimate the market cost distribution. The baseline in models 2 and 3 reflects the cost distribution of other independent banks; model 4 adds the cost dispersion for members of bank holding companies. The coefficient for holding company dispersion is near zero, while that for independent banks remains positive and highly significant. This suggests that potential entrepreneurs compare themselves to other independents rather than to the large bank holding companies.

The main unexpected result is that the variables we use to capture opportunity cost are of the wrong sign in all models (proposition 4). Entry increases with income, W, and the real-estate price index, K. This result may be due to poor choice of measures. W and K are measures of income and real estate prices across all sectors rather than specific to banking. One possible explanation for why they take on the unexpected sign is that the measures capture liquidity constraints better than they capture opportunity cost. In particular, real estate prices may represent homeowner's equity that entrepreneurs can tap for the initial investment, and income may represent a spousal income that can sustain the family during the startup process.

One final issue pertains to timing. When do entrepreneurs form their estimates of the market conditions? We tested five different lags for the explanatory variables[11]. While coefficients in all models maintain their sign, the most powerful model has one year lags. Further lags yield decay in coefficient magnitude and level of significance. Given these results it appears that entrepreneurs observe market conditions in one year, and then enter the following year. This suggests a one-year process to design operations and secure resources for entry, which is consistent with anecdotal evidence that the startup process takes eighteen months.

7. Discussion

The goal of this paper was to reconcile the risk-bearing role of entrepreneurs with the stylized fact that entrepreneurs exhibit conventional risk aversion profiles. We proposed that the disparity arises from confounding two distinct dimensions of uncertainty: demand uncertainty and ability

[11] The results are available upon request.

uncertainty. We further proposed that entrepreneurs will be risk averse with respect to demand uncertainty, while "risk-seeking" (overconfident) with respect to ability uncertainty. To examine this view we modeled the entrepreneurial entry decision, then tested it empirically. In the model, entrepreneurs compare the expected value of an uncertain profit stream against the opportunity cost of continuing in wage employment. The baseline model anticipates that with rational options behavior, entry will be increasing in mean cost, and decreasing in the failure rate as well as the entrepreneur's opportunity cost. The model with risk preferences adds variables for demand uncertainty as well as cost uncertainty. We tested the models across markets and over time in the banking industry. We found that entrepreneurs behave rationally, but that in addition they are risk averse with respect to demand uncertainty and "risk seeking" (overconfident) with respect to cost uncertainty.

Also of interest is the fact that responding rationally to cost uncertainty and demand uncertainty requires an ability (if only tacit) to estimate cost distributions and demand distributions. Given they respond rationally, it appears entrepreneurs are able to form reasonable estimates of these distributions.

These results reconcile entrepreneurs' risk aversion with their role as economic risk-bearers. Entrepreneurs are willing to bear economic risk when the degree of ability uncertainty is comparable to the degree of demand uncertainty. In those instances, overconfidence will compensate for risk-aversion, and we will see sufficient entry. This appears to be the case in banking. A potential market failure exists however in instances where there is a high degree of demand uncertainty, but low ability uncertainty. In these instances entrepreneurial risk aversion may dominate overconfidence, and there may be insufficient entry. As a consequence, those markets may be less competitive and less innovative. Indeed six of the ten industries with the lowest entry rates have this character (low performance dispersion and high demand fluctuation)[12]. The entry rate in these industries is an order of magnitude lower than in the economy generally.

[12] These industries are: doctors offices, social services, commercial printing, engineering and architectural services, hotels and motels and educational services.

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Table 1. Stage 1 Data Summary

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
c	cost	174869	7.98	1.27	-0.82	16.76
w1	price_labor	174673	2.97	0.28	-4.85	9.39
w2	price_physical capital	173999	-1.64	0.73	-9.93	5.63
w3	price_capital	173789	-3.54	0.41	-12.58	3.32
y1	mortgage	172503	9.47	1.58	-1.37	17.86
y2	other loans	173373	9.63	1.40	-0.70	18.55
y3	securities	173828	9.58	1.47	-1.27	17.51

Units: ln(thousand - 1996 dollars)

Variable	c	w1	w2	w3	y1	y2	y3
c	1						
w1	0.1929*	1					
w2	-0.0418*	0.2792*	1				
w3	0.1464*	0.0921*	0.0452*	1			
y1	0.8640*	0.1151*	-0.1322*	-0.0463*	1		
y2	0.9146*	0.1493*	-0.0594*	0.1201*	0.7711*	1	
y3	0.7603*	0.0821*	-0.0922*	0.0259*	0.6883*	0.6934*	1

Table 2. Results from Stage 1 Regression

Dependent Variable: ln(cost) 170859 observations					
	Coef.	**se**		**Coef.**	**se**
w1	-8.691e-01**	(30.644)	**w1w3**	-2.312e-01**	(61.988)
w2	-2.085e-01**	(17.544)	**1/2*w2sq**	-4.964e-03**	(4.675)
w3	2.078e+00**	(85.535)	**w2w3**	-2.519e-02**	(15.625)
y1	1.942e-02*	(2.073)	**1/2*w3sq**	2.564e-01**	(72.979)
y2	4.262e-01**	(41.009)	**y1w1**	3.230e-02**	(22.174)
y3	2.784e-01**	(30.382)	**y1w2**	-7.015e-04	(0.969)
1/2*y1sq	9.331e-02**	(165.733)	**y1w3**	-3.159e-02**	(24.569)
y1y2	-6.028e-02**	(120.751)	**y2w1**	-2.019e-02**	(12.595)
y1y3	-2.049e-02**	(39.425)	**y2w2**	-9.330e-03**	(10.312)
1/2*y2sq	1.225e-01**	(165.107)	**y2w3**	2.952e-02**	(21.413)
y2y3	-5.541e-02**	(95.188)	**y3w1**	-3.038e-02**	(21.670)
1/2*y3sq	8.827e-02**	(190.369)	**y3w2**	1.418e-02**	(19.267)
1/2*w1sq	2.011e-01**	(43.998)	**y3w3**	1.620e-02**	(12.903)
w1w2	3.016e-02**	(16.267)	**Constant**	5.320e+00**	(54.442)
			$E(u_{it} \mid e_{it})$	1.707e-01**	0.172

Absolute value of t statistics in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 3. Summary of Data for Stage 2

663 observations

Variable	Mean	S.D.	Min	Max
$entry_{jt}$	2.56	5.09	0.00	66.00
$\ln(incumbents)_{jt}$	4.87	1.22	1.95	7.59
$growth(demand_{jt-1\ to\ jt-11})$	0.08	0.05	-0.17	0.37
$CR4_{jt-1}$	0.50	0.23	0.11	0.98
$\ln(average\ income)_{jt-1}$	9.95	0.17	9.50	10.40
$(housing\ price)_{jt-1}$	160.50	46.42	83.72	317.12
$mergers_{jt}$	0.04	0.05	0.00	0.34
$failure_{jt}$	0.01	0.03	0.00	0.29
$\mu(c_{ind})_{jt*}$	0.18	0.07	0.07	0.62
$\mu(c_{ind})_{jt*}failure_{jt}$	0.00	0.01	0.00	0.07
$\sigma(c_{ind})_{jt}$	0.55	0.16	0.14	1.47
$RMSE(demand_{jt-1\ to\ jt-11})$	0.07	0.06	0.01	0.37
$\sigma(c_{hold\ co})_{jt}$	0.55	0.22	0.02	1.62

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1	$entry_{jt}$	1.00												
2	$\ln(incumbents)_{jt}$	0.33	1.00											
3	$growth(demand_{jt-1\ to\ jt-11})$	0.15	-0.15	1.00										
4	$CR4_{jt-1}$	-0.11	-0.75	0.10	1.00									
5	$\ln(average\ income)_{jt-1}$	0.04	-0.22	-0.04	0.35	1.00								
6	$(housing\ price)_{jt-1}$	0.00	-0.32	0.08	0.38	0.68	1.00							
7	$mergers_{jt}$	0.02	-0.10	-0.16	0.11	0.15	0.17	1.00						
8	$failure_{jt}$	-0.05	-0.11	0.00	0.11	0.10	-0.01	0.12	1.00					
9	$\mu(c_{ind})_{jt*}$	0.05	-0.37	0.09	0.43	0.09	0.09	0.09	0.21	1.00				
10	$\mu(c_{ind})_{jt*}failure_{jt}$	-0.04	-0.14	0.00	0.15	0.09	-0.01	0.13	0.95	0.30	1.00			
11	$\sigma(c_{ind})_{jt}$	0.08	-0.26	0.21	0.29	0.32	0.38	0.06	0.01	0.68	0.06	1.00		
12	$RMSE(demand_{jt-1\ to\ jt-11})$	-0.09	-0.42	0.20	0.36	0.41	0.28	0.12	0.29	0.28	0.28	0.26	1.00	
13	$\sigma(c_{hold\ co})_{jt}$	0.01	-0.27	0.05	0.30	0.33	0.31	0.06	0.11	0.37	0.14	0.34	0.49	1.00

Table 4. Test of Propositions
Dependent variable is $entry_{jt}$

	(1)	(2)	(3)	(4)
$failure_{jt-1}$		-27.730**	-26.272**	-25.874**
		(3.264)	(3.102)	(3.073)
$mergers_{jt-1}$		1.553+	1.585+	1.688+
		(1.678)	(1.705)	(1.799)
$\mu(c_{ind})_{jt-1}$		-1.241	-3.386*	-3.685*
		(0.891)	(2.176)	(2.333)
$\mu(c_{ind})_{jt-1*}failure_{jt-1}$		103.044**	106.578**	107.372**
		(3.189)	(3.331)	(3.365)
RMSE($demand_{jt-1\ to\ jt-11}$)			-2.333*	-2.354*
			(2.115)	(2.079)
$\sigma(c_{ind})_{jt-1}$			1.713**	1.760**
			(3.477)	(3.536)
$\sigma(c_{hold\ co})_{jt-1}$				-0.008
				(0.028)
$incumbents_{jt-1}$	-1.181**	-1.148**	-1.397**	-1.412**
	(3.397)	(3.365)	(3.443)	(3.334)
growth($demand_{jt-1\ to\ jt-11}$)	6.349**	6.333**	6.750**	7.031**
	(4.852)	(4.696)	(4.848)	(4.873)
$CR4_{jt-1}$	-2.511**	-2.691**	-2.775**	-3.045**
	(3.535)	(3.754)	(3.671)	(3.858)
(average income)$_{jt-1}$	4.467**	4.620**	5.116**	4.700*
	(2.669)	(2.658)	(2.826)	(2.525)
(housing price)$_{jt-1}$	0.006**	0.006**	0.002	0.001
	(2.798)	(2.620)	(0.805)	(0.562)
Year effects	***	***	***	***
Constant	-35.993*	-37.404*	-40.379*	-35.867*
	(2.294)	(2.273)	(2.375)	(2.046)
Log Likelihood	-897.191	-890.621	-882.326	-870.945
Wald Chi2	230.263**	241.919**	267.227**	262.43**
Observations	663	663	663	655
Number of markets	51	51	51	51

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

Figure 1. New bank charters across all markets

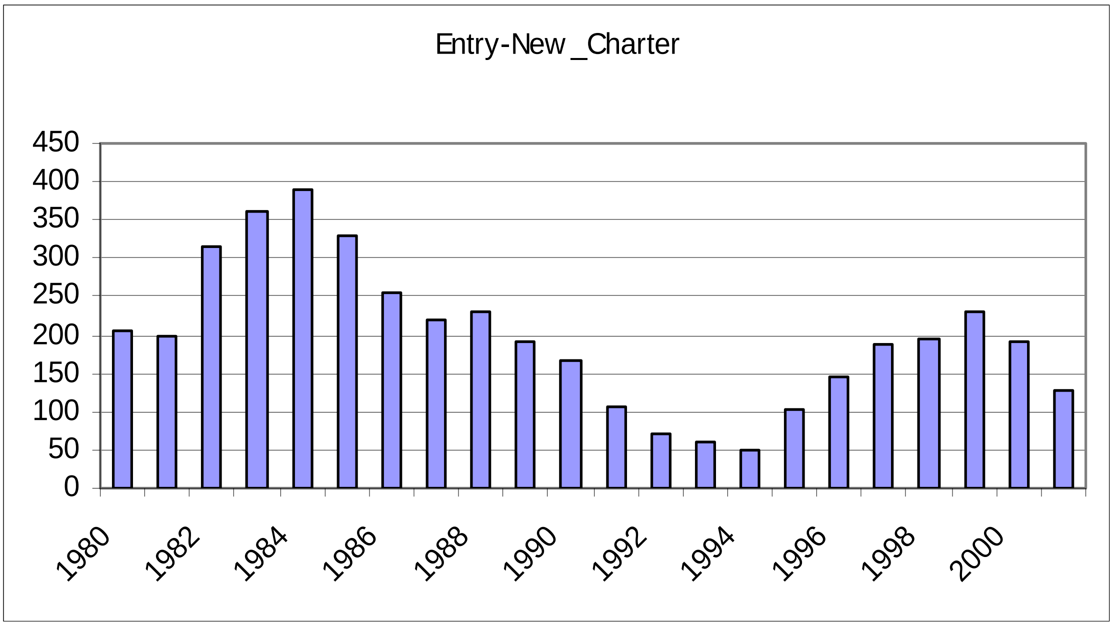

Figure 2a. Histogram of firm-year efficiency metrics

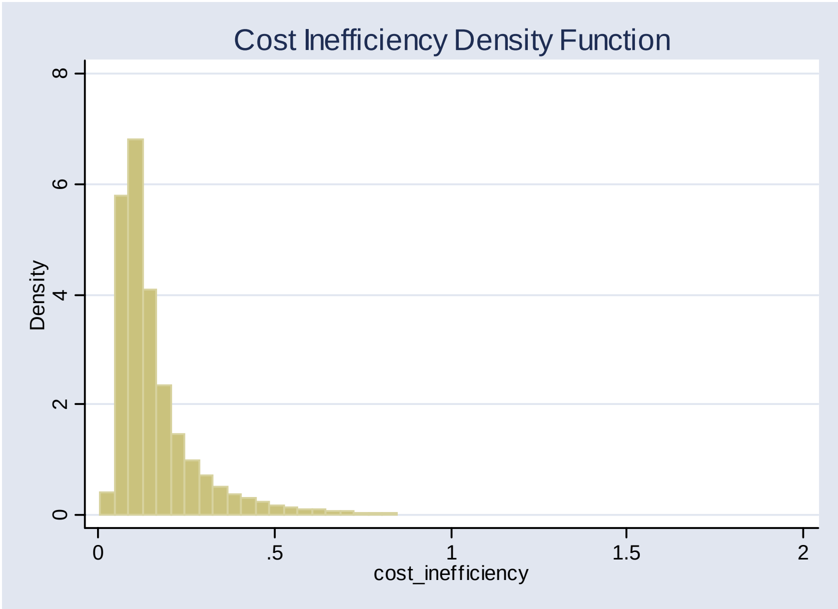

Figure 2b. Mean Cost Inefficiency