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Abstract

Limited personal liability for debts has long been justified as a tool to promote entrepreneurial risk taking by providing insurance to the borrower in the event of low returns. Nonetheless, such limits erode repayment incentives, and so may increase unsecured borrowing costs. Our paper is the first to evaluate the tradeoff between credit costs and insurance against failure. We build a life-cycle model with risky, and repeated, occupational choice in the presence of defaultable debt contracts. We find that limits to liability can encourage self-employment, and alter the timing, size, and financing of self-employment projects. We also find that the positive relationship between wealth and self-employment rates may not be evidence for credit constraints: We show that such a relationship is present even when limited liability is eliminated.

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1 Introduction

Borrowing constraints are seen as a significant barrier to entrepreneurial activity in the US. The perception of such constraints has led to the creation of agencies such as the US Small Business Administration, which channels billions of dollars of credit to entrepreneurs.[1] Moreover, current public policy is crucially premised on the view that borrowing constraints arise, ultimately, from the risk of borrower default. Striking evidence for this view is seen in the pervasive use of loan *guarantees*, rather than outright grants. The former, after all, could be expected to improve access to credit only if borrowing constraints arose from default risk. Similarly, recent work of Rosen and Willen (2002) also argues that credit market frictions may be important; they find that absent credit constraints, observed self-employment rates in the U.S. are too low to be justified in a simple risk/return analysis.

If indeed default risk limits credit access, where does it come from? A primary suspect for small business borrowers is US personal bankruptcy law. As practiced, the non–waiveable legal right to bankruptcy protections leaves entrepreneurs, and especially sole proprietors, with no credible way of committing to repay unsecured debts. The bankruptcy process not only removes all unsecured debt, but also allows, in many cases, for some wealth to be retained by borrowers. More generally, any legal limit to liability for debts means that borrowers, especially those with low personal wealth, pose a risk to lenders that implies greater costs to start a venture.

Given the clear drawbacks such statutes create, why do they exist at all? Here, the answer is that small business is seen as an inherently high-risk activity where actuarially fair insurance against failure is difficult, or impossible, to obtain. In the absence of markets against such risks, bankruptcy and other limits to liability allow borrowers to partially tailor loan repayment to avoid severe reductions in their standards of living in the event of poor returns on investment.

The tension between insurance provision and credit access was recognized very early in US history. The initial political debate on limited liability in general, and bankruptcy in particular, in the 1700s revolved squarely around balancing access to credit with a form of insurance against catastrophic failure, and is documented in Moss (2000). In the end, the provision of insurance was seen as most important, and bankruptcy provisions

[1] Throughout the paper, we will use the terms entrepreneurship and self–employment interchangeably. Our focus is on the role played by credit markets in driving risky occupational choices. We therefore want our definition of self-employment to be broad enough to capture anybody whose primary income arises from a risky business in which they have a large and poorly-diversified interest. In turn, we do not want to restrict the set of entrepreneurs to only the (much smaller) subset of individuals who may possess exceedingly productive or innovative project ideas.

were viewed by the majority as an aid, not a barrier, to entrepreneurship in the US. This benign view of limited personal liability continues to have adherents. For example, Lawless and Warren (2005) argue that strict bankruptcy law stifles entrepreneurial risk–taking (see also The Economist, 2006).

In addition to credit conditions, those contemplating self-employment must evaluate its payoff relative to their prospects as paid workers. The potentially important role played by opportunity costs arising from alternatives to self-employment is suggested to us by the persistent empirical regularity that entrepreneurship is chosen relatively more often by those with poor current corporate sector opportunities. Evans and Leighton (1989), Farber (1999), Rissman (2003), and Fairlie and Krashinsky (2006) each show that in the data, poor opportunities for "wage" work are important in generating the switch to self-employment. Specifically, prior job loss, displacement, and high local unemployment rates are each associated with a heightened likelihood of entrance to self–employment. Thus, credit conditions can affect individuals' *labor* income though their impact on self-employment decision. This feature motivates a central aspect of the timing of resolution of uncertainty in our model: Households first learn their productivity in the "paid" work sector and then choose whether or not be an entrepreneur.

Since limits to liability may actually create the credit constraints that other major policies aim to mitigate, it is important to clarify their effect on credit markets and, in turn, entrepreneurial activity in the US. The main contribution of this paper is to provide a detailed quantitative evaluation of how US limited liability policy affects aggregate entrepreneurship rates and unsecured credit conditions, and whether the outcomes are, in turn, desirable from a welfare standpoint. We model occupational choice over the life cycle, and our analysis emphasizes the role of household-level decisions generating the preceding aggregates. In particular, we measure the role played by liability policy in influencing credit constraints, risk taking, and self-employment choices over the entire life cycle.

Our main results are as follows. First, we find that when limited liability is varied between full liability and current US levels, the insurance provided by the default option largely offsets the disincentives arising from higher credit costs, resulting in minor changes in self-employment activity. However, when liability is reduced beyond the current US levels, the associated default risk increases credit costs sufficiently to limit credit use, which in turn discourages self-employment. Second, we demonstrate that the positive correlation between wealth and self-employment does not imply the existence of credit constraints, as it arises primarily from the interaction of risk and life-cycle savings behavior. Third, changes in liability policy have distributional implications. In particular, limited liability appears regressive with respect to age. We find that very low liability sharply affects the young, but has only minor effects on the old, primarily because the latter have accumulated wealth for retirement. In contrast to its effects on age, liability policy does not appear to affect high- and low-skilled households differentially. Lastly, very low-liability regimes significantly alter the ability of households to switch occupations in the event of low corporate sector productivity.

Our study is novel along three dimensions. First, our work is novel in using quantitative theory to understand the role that limited liability plays in risk taking, as opposed to risk sharing of an exogenous income stream.[2] Second, by incorporating the "real" options of entry and exit, we are able to discern the effects of liability policy on not just the intensive margin (i.e., project size) of self-employment, but also the extensive margin (i.e., the rate of self-employment). As a result, we overcome the fact that data on self–employment is by definition censored, capturing only those for whom such a choice was preferred to an unobserved alternative. Third, our model produces a full schedule of interest rates for debt, on and off the equilibrium path. This allows us to overcome the classical problem of the identification of credit demand and supply. As Berkowitz and White (2004) (footnote 29, p16) acknowledge: "Presumably, firms apply for the amount of credit they expect lenders to provide, and lenders may tell borrowers in advance how much they are willing to lend."

Our work is most closely related to Cagetti and De Nardi (2006), but differs in two key ways. First, in Cagetti and De Nardi (2006), production is riskless, as the self-employed know their productivity at the time of borrowing. As a result, limited commitment to repay debt can only limit borrowing. By contrast, our set-up captures the original impetus for debt relief of allowing debt repudiation to encourage risky investment. In our model, therefore, households first borrow, then realize the stochastic output from the project. Second, we do not derive debt limits by assuming that default is met by permanent autarky. Rather, we treat the decision not to repay debt as it is treated in practice, whereby households are forced to surrender wealth above a threshold in return for debt forgiveness. In turn, our model generates such exchanges in equilibrium, which are naturally interpretable as "bankruptcies" as they are measured in the data. Additionally, the presence of equilibrium bankruptcy means that interest rates will vary with the risk associated with any entrepreneur-project pair. Therefore, our model captures the empirical regularity that low-wealth borrowers face higher credit costs, and hence are more credit "constrained." By contrast, in Cagetti and De Nardi (2006), all debt is risk-free in equilibrium and, therefore, its price cannot feature a default premium or vary across borrowers with different default risks. Our work is also related to Terajima (2004), who studies a general model of occupational choice but

[2] See e.g., Athreya (2006), and Chatterjee et al. (2002).

abstracts from credit frictions altogether. Similarly, Meh and Terajima (2005) focus on bankruptcy and home ownership decisions in a model related to Terajima (2004) where, in sharp contrast to our work, occupations are chosen before any uncertainty is resolved. Lastly, relative to Polkovnichenko (2003), we study a fully dynamic model of occupation choice over the life cycle, along with a detailed account of the credit market and its lending terms.[3]

The remainder of the paper is organized as follows. Section 2 illustrates the key tradeoffs that we evaluate. Sections 3 and 4 present and parameterize the model; Section 5 reports and discusses results. Section 6 concludes.

2 Exemptions and Credit: Intuition from a Static Model

As a preliminary step to motivate our richer quantitative model, we first provide intuition for the main forces at work in a simple example.[4] Let there be two periods, 0 and 1. In period 0 households with internal wealth a_0 sign one-period debt contracts with lenders and receive "D" units of resources. Contracts are exogenously specified to resemble debt in that they are completely non-contingent outside of bankruptcy. The total investment in the project is then of size $k = a_0 + D$. In period one, stochastic productivity θ is drawn according to the p.d.f. $\pi(\theta)$ from the bounded support $[\underline{\theta}, \overline{\theta}] \in R_{++}$. Given θ, output is denoted by $f(k(a_0, D), \theta)$. Given output, the household decides on whether to repay the debt with interest or file for bankruptcy at cost τ. Lenders must charge an interest rate that depends on the size of the loan and the exemption in order to break even, given a gross cost of funds R^f; we denote the net zero-profit interest rate by $R(D, \overline{x})$. For simplicity, in what follows, let $a_0 = 0$, so that $k = D$.

There are two thresholds for productivity, θ_1, and θ_2, that determine the payments in default and non-default states. The threshold θ_1 is defined by the level of productivity that makes output equal to the exemption, given project size k. The threshold θ_2 is defined by the level of productivity that makes output exceed the exemption by the gross-of-interest debt $R(D, \overline{x})D$; i.e. $\theta_2 = \{\theta | f(D, \theta) - \overline{x} = R(D, \overline{x})D\}$. The household's expected utility under a given exemption $\overline{x}$, for a given face value of debt D is then:

[3] The literature is vast, but other important studies include Evans and Jovanovic (1989), Banerjee and Newman (1991), Quadrini (2000), Albuquerque and Hopenhayn (2004), Quintin (2003), Krasa et al. (2004), and Mondragon (2006). In each of the preceding, however, limited commitment can only limit self-employment, and the questions are then: by whom and by how much?

[4] We are grateful to Marco Bassetto and Chris Sleet in what follows.

$$V(D,\overline{x}) = \int_{\underline{\theta}}^{\theta_1} u(f(D,\theta)-\tau)\pi(\theta)d\theta + \int_{\theta_1}^{\theta_2} u(\overline{x}-\tau)\pi(\theta)d\theta + \int_{\theta_2}^{\overline{\theta}} u(f(D,\theta)-R(D,\overline{x})D)\pi(\theta)d\theta \tag{1}$$

Notice that the cutoff points θ_1 and θ_2, as well as the payment R, are all functions of $\overline{x}$. Thus, when $\theta \in [\underline{\theta}, \theta_1]$, the household prefers to default, and can keep all of its output less the cost of bankruptcy, $f(k,\theta) - \tau$. When $\theta \in (\theta_1, \theta_2]$, it consumes $\overline{x} - \tau$ as it files for bankruptcy, pays τ, and keeps output equal to the exemption. When $\theta \in (\theta_2, \overline{\theta}]$, the household does not file for bankruptcy, and so repays debt and keeps the remainder: $f(D,\theta) - R(D,\overline{x})D$.

Under the preceding bankruptcy filing behavior of households, a lender who lends the household D units must receive an expected payoff that satisfies:

$$R^f D = 0\int_{\underline{\theta}}^{\theta_1} \pi(\theta)d\theta + \int_{\theta_1}^{\theta_2} \left(f(D,\theta) - \overline{x}\right)\pi(\theta)d\theta + R(D,\overline{x})D\int_{\theta_2}^{\overline{\theta}} \pi(\theta)d\theta \tag{2}$$

If bankruptcy is costless, i.e. $\tau = 0$, and households are risk averse, the optimal exemption $\overline{x}^*_{\tau=0}$ for any *given* borrowing level D, is the highest level under which the lender still recovers $R^f D$ in expectation. This is because a higher exemption weakly increases both thresholds θ_1 and θ_2, and thereby shifts the states in which repayment occurs to progressively higher productivity states. Risk aversion makes this weakly better for the household, while lenders are indifferent because, by assumption, households repay an expected payment of $R^f D$. Therefore, when $\tau = 0$, the optimal exemption $\overline{x}^*$ for a loan of size D solves:

$$\overline{x}^*(D) = \arg\max_{\overline{x}} V(D,\overline{x}) \text{ subject to (2)} \tag{3}$$

In other words, for any given debt level D, when bankruptcy is costless, the borrower seeks the highest exemption $\overline{x}^*$ for which there is an interest rate $R(D,\overline{x})$ that allows lenders to break even. This idea is formalized as follows.

Theorem 1 *Assume that the bankruptcy cost, τ, is zero. For an arbitrary borrowing level D, the utility of the risk-averse entrepreneur, $V(D,\overline{x})$, is increasing in the exemption level, $\overline{x}$ if there exists a payment schedule $R(\overline{x})$ that satisfies* (2).

Proof. See Appendix. ■

As a result, within the class of debt contracts studied in this paper, the best static arrangement for the household then must solve:

$$D^* \equiv \arg\max_D V(D, \overline{x}^*(D)). \tag{4}$$

An implication of the preceding result is that if households are *not* given the flexibility to choose exemptions and borrowing simultanously, they may not be able to attain certain debt levels. That is, under a bounded support for productivity, the lender's break-even condition (2) implies that if exemptions rise, the most that an agent can feasibly borrow falls. That is, if a "high" legal exemption is imposed, bankruptcy will be ex-post optimal for the household in enough states that the lender will find it infeasible to recoup a large loan. More precisely, whenever the legal exemption $\overline{x}_{legal} > \overline{x}^*(D^*)$, then *unless* $R(D^*, \overline{x}_{legal})$ exists, the debt level D^* will not be feasible. Whenever this occurs, the limited commitment created by a legally imposed exemption will create credit constraints for households. Moreover, whenever legal exemptions are set at levels that prevent some households from attaining their desired level of borrowing, their ability to choose an occupational choice will be compromised.

Another reason why exemptions may hinder household decision making is that bankruptcy itself is, by all accounts, a costly procedure (see, e.g., Fay, Hurst, White (2002), Robe et al. (2007), and Athreya (2005)). Costly bankruptcy generates deadweight losses, meaning that even for an arbitrarily given borrowing level, exemptions should no longer necessarily be made as large as possible. That is, if exemptions are set such that bankruptcy occurs often in equilibrium, households may be able to do better by repaying fully in more states and filing for bankruptcy less frequently, thereby avoiding deadweight losses.

Lastly, as noted earlier, two potentially crucial factors in determining credit use and occupational choice are (i) the relative risk of self-employment to paid work and (ii) the dynamics of life-cycle earnings. The role of exemptions for self-employment is, therefore, ultimately a quantitative question, and so we turn next to a fully dynamic model of unsecured credit and occupational choice over the life cycle.

3 A Dynamic Model of Credit and Self-Employment

3.1 Preferences

The economy is represented by an overlapping generations model of households who work for $J-$periods, then retire, and are replaced by the next generation of workers. Each generation consists of a continuum of ex-ante identical agents who maximize the expected, additive, and discounted sum of utilities from consumption. Working age is discrete and is indexed by $j = 1, 2, ... \ J$. An agent's consumption in age$-j$ is denoted by c_j. The within–in–the period utility function is given by $u(.)$ where $u'(.) > 0$, $u''(.) < 0$. Following work life, households retire and save an amount a_{J+1} to provide consumption in retirement. The valuation of resources at the time of retirement is given by the function $\phi(.)$. We assume that $\phi'(.) > 0$ and $\phi''(.) < 0$. Therefore, given the discount factor $\beta_h \in (0, 1)$, households maximize:

$$E_0 \sum_{j=1}^{J} \beta_h^{j-1} u(c_j) + \phi(a_{J+1}). \tag{5}$$

An important aspect of our model is that we use the simplest framework possible to isolate the effect of limited liability on (i) access to credit and (ii) the self-selection of households into entrepreneurial activity and paid work.[5] Our goal is not, for example, to uncover the role of entrepreneurship for inequality, as many previous studies have done. Therefore, we do not assume "persistence" in entrepreneurial ability across generations, nor do we assume entry and exit costs or the presence of fixed scales for project size, as in Quadrini (2000), e.g. We also abstract from complex details of the tax system.[6] Our approach, by contrast, builds in substantial detail to clearly investigate the way in which limited liability, especially as created by bankruptcy law, **(i)** alters unsecured credit provision and use,**(ii)** self-selection into self-employment, **(iii)** and entrepreneurial project size.

3.2 Timing, Occupational Choice, and Default

In each period, households choose between being a worker or an entrepreneur.[7] At the beginning of each period, a household draws its stochastic productivity in paid/corporate-sector work, and thereby knows its income under that occupation with certainty. However, if they choose instead to become self-employed, the household knows only the probability distribution of entrepreneurial productivity.

With respect to the corporate sector, labor productivity takes on values in a finite set, i.e., $\epsilon^j \in \{\epsilon_1^j, \epsilon_2^j, ... \epsilon_N^j\}$, for $j = 1, ..., J$, with each period's shock drawn according to the (possibly) age-dependent probability distribution $g_j(\epsilon)$. We denote the mean

[5]Throughout the paper, we will use the terms entrepreneurship and self–employment interchangeably. Our focus is on the role played by credit markets in driving risky occupational choices. We, therefore, want our definition of self-employment to be broad enough to capture anybody whose primary income arises from a risky business in which they have a large and poorly-diversified interest. In turn, we do not want to restrict the set of entrepreneurs to only the (much smaller) subset of individuals who may possess exceedingly productive or innovative project ideas.

[6]See Meh (2005) for the effects of taxes on entrepreneurship.

[7]We also rule out "mixing" salaried work and self-employment for self-insurance purposes.

level of corporate sector productivity at age-j, for human capital h, by $\mu^{Corp}(j,h)$.[8] The age-dependence of $g_j(\epsilon)$ will allow us to capture the life-cycle path of corporate-sector labor productivity. The labor income of an agent is then given by $\epsilon_n \mu^{Corp}(j,h)$.

By contrast, an agent who chooses entrepreneurship operates a stochastic technology denoted by $\mathcal{F}(\theta,k)$ whereby gross output depends on the privately observed shock, θ, and the capital stock, k. The productivity shock θ takes values in $\{\theta_1,...,\theta_N\}$, and its human capital–specific probability density function is given by $\pi_h(\theta)$. The variable k can take values on the set $k=[0,\overline{k}]$ where $\overline{k}$ is an endogenous upper bound. To capture the presence of uninsurable entrepreneurial and labor income risks, insurance contracts with payments contingent on workers' and entrepreneurs' productivities are assumed to be unavailable. As will be discussed later, to avoid introducing any frictions to entry and exit, we assume that productivity across salaried work and self–employment is uncorrelated.

In the model, both entrepreneurial productivity as well as corporate-sector productivity are increasing functions of the human capital index, h. Human capital also reflects constant (permanent) productivity differences between agents during working life and is exogenously determined in the first period of the agent's life.[9]. Therefore, a useful interpretation of h, when it is employed in entrepreneurial activity, is that it captures the ability of an agent to generate and execute productive ideas for an entrepreneurial project. The advantages enjoyed by those with a general set of skills to pursue self-employment have been widely documented, most recently in Lazear (2005). Given the evidence, as well as the difficulties in directly observing the distribution of "ideas," we assume at the outset that college–educated agents have higher average productivity than their high school–educated counterparts. Additionally, we discipline our model by requiring that our benchmark parameterization matches the human capital distribution among the self-employed, which, in contrast to "ideas", is something that is well-measured.

An agent who chooses to become an entrepreneur in period t may finance the project with any internal wealth $a \geq 0$, as well as external borrowing through a bond issue of face value $b \geq 0$. We rule out the possibility of equity issuance by entrepreneurs.[10]

[8]The uncertainty of wage income eliminates the possibility of a non-degenerate wealth distribution and makes the dynamics of agent's wealth interesting.

[9]Human capital may be interpreted as an agent's education level, e.g., college graduate vs. non-college graduate.

[10]For instance, entrepreneurs in the model cannot raise funds from "venture capitalists." There are two reasons why we make this assumption. First, the goal of the paper is to uncover the tension of insurance and discounting of risky debt contracts, without resorting to benefits of growth–enhancing entrepreneurial projects. Second, potential entrepreneurs with growth–enhancing projects are more

Default risk on debt depends on the size of the project, the size of the loan, and the ability of the entrepreneur. Given the observability of educational attainment as a proxy for the presence of general skills, competition among lenders requires this information be used. Bond prices, therefore, depend on loan size, internal wealth, and the level of human capital, and are denoted by $q(h, a, b)$. Given the discount rate, a bond issue of face value b yields ultimately generates a loan of $q(h, a, b)b$ units of capital. The entrepreneur's project size is then simply the sum of the loan and internal funds, and is denoted by k, where $k \equiv q(h, a, b)b + a$.[11] Once the project size is determined, the entrepreneur observes the shock θ, whereby output is determined. The agent then evaluates the default option. If the entrepreneur chooses not to default, the face value of the loan b must be repaid. If the entrepreneur chooses to default, output and the productivity shock θ and, hence, output, become publicly observed.

Our treatment of limited liability for the self-employed corresponds most closely to the structure defined by US Chapter 7, "Fresh Start", personal bankruptcy policy. In particular, these provisions determine the maximal wealth that the defaulting household may retain, by means of an "exemption" level. First, denote the sum of current output and undepreciated capital by $F(\theta, k)$, i.e. $F(\theta, k) \equiv f(\theta, k) + (1 - \delta)k$. We denote exemptions by $\overline{x}$, whereby given output $\mathcal{F}(\theta, k)$, post-default wealth is simply $\min\{(\mathcal{F}(\theta, k), \overline{x}\}$. Thus, higher exemptions allow for more wealth to be sheltered while debts are repudiated.[12] Throughout this paper, limited liability will be completely defined by the parameter $\overline{x}$. A defaulting household must also pay transactions costs, denoted by τ_B.[13] Specifically, the payoff to repudiating debts depends on output, which in turn depends on the human capital level h, the shock value θ, the current wealth level a, the face value of the loan, b, and the prevailing exemption level, $\overline{x}$. Following the decision to repay debt, the household divides its remaining resources by choosing current consumption c_j and wealth a_{j+1} for the next period.

If default occurs, lenders seize wealth by using a liquidation technology whereby they receive any entrepreneurial output (including undepreciated capital) above the

likely to raise capital from venture capitalists, and therefore, can potentially avoid limited commitment problems in debt contracts.

[11] Representing borrowing by nonnegative scalar b is convenient as it makes the capital stock a nondecreasing function of borrowing for all $q \geq 0$.

[12] Notice that the exemption level, $\overline{x}$, is applied to gross output, whereas bankruptcy law often has asset-specific exemptions, typically protecting equity in the primary residence of the borrower. However, case law generally allows the conversion of non-exempt assets (the gross output, $F(\theta, k)$) into exempt assets prior to bankruptcy filing. See, e.g., Huckfeldt (1991) and footnote 3 in Fay, et al. (2002).

[13] These losses include not only legal fees required for filing a bankruptcy petition, but also difficulties in conducting transactions such as renting a home, car, etc.

exemption level. In our model depreciation represents the composite effect of all factors that transform a given project size in the current period into durable capital stock tomorrow. Therefore, the correct interpretation of the parameter δ is the following. Given that we do not explicitly model labor supply by entrepreneurs, or labor hired by small businesses, the stock of durable capital available one period hence is reduced by the sum of both physical depreciation and any expenditures on "working capital." When productivity and bankruptcy decisions have been made, households choose consumption and savings. The period then ends. The timing is summarized in Table 1.

In the last period of working-life, the household solves the same problem involving the occupational choice and the bankruptcy option described above. However, at the end of the period, the household values wealth carried into retirement according to the function $\phi(.)$. The household then retires, and consumes its wealth. Each retiring household is then replaced by the next generation, which holds no financial wealth as it begins its working life. These new households then realize a human capital level h' drawn from a probability distribution $\varsigma(h'|h)$ that depends explicitly on parental human capital.

3.2.1 Can borrowers "opt out" of the bankruptcy option?

A useful feature of our model is that it accomodates the idea that recent financial innovation may now allow entrepreneurs to effectively "opt out" of the bankruptcy protection provided by the law. Specifically, financial products may now enable households to easily liquefy wealth, which then can be pledged as collateral. An example of a contractual arrangement that undoes the effects of the bankrupcy code is the reverse-mortgage contract. The reverse-mortgage contract is equivalent to a secured loan in which the lender receives some or all of the equity in the entrepreneur's house in return for funds lent to the entrepreneur. As a result, an entrepreneur with a house worth a units can simply convert his equity into funds and run a business of size $k = a$ [14]. In the model, we capture this possibility: A self-employed agent with internal wealth a can credibly pledge to repay more than one with less wealth–which is the essence of posting collateral, and thereby overcoming the limits to commitment created by a relatively large exemption. Furthermore, as long as the entrepreneur does not default in any state of the world, he can access secured credit even beyond this level (i.e., $k > a$) depending on the exemption level.

[14] Thus, the model allows for reverse-mortgage loans even when the exemption level is unbounded, as is the case for seven states in the U.S.

3.2.2 Loan Contracts

Lenders are perfectly diversified and are assumed to observe an agent's wealth, human capital, and loan size. The current entrepreneurial productivity shock is not observable at the time a loan is agreed upon. Competition in financial markets requires that, in equilibrium, there are zero expected profits on each loan. Let $(1+r^f)$ denote the gross risk–free interest rate on savings, and let τ denote proportional transactions costs associated with the intermediation of funds. Therefore, the cost of collecting one unit of funds by the lender is given by $(1+r^f+\tau)$. Given $(1+r^f+\tau)$, the zero-profit discount rate on a risk-free loan, which we denote by q^f, is given as follows. The zero-profit discount rate is then simply the reciprocal. That is,

$$q^f = \frac{1}{1+r^f+\tau}. \tag{6}$$

For any given internal wealth and debt level, there is a (possibly empty) set of realizations for productivity, denoted $\Lambda(h,a,b,q)$, such that the agent prefers default to repayment whenever $\theta \in \Lambda(h,a,b,q)$. Notice that, in general, the pricing scheme q and default decision Λ influence each other. In particular, the pricing applied to any given bond issuance affects the scale of a project and, in turn, ex-post repayment incentives.

The set $\Lambda(h,a,b,q)$ is restricted by the condition that the face value of debt cannot be less than the liquidation value of the entrepreneur's assets. Let $\sigma(h,a,b,q)$ be the endogenous probability of default for such an agent, namely

$$\sigma(h,a,b,q) \equiv \Pr(\theta \in \Lambda(h,a,b,q)) = \sum_{\theta \in \Lambda(h,a,b,q)} \pi(\theta). \tag{7}$$

The amount

$$\Omega = \sum_{\theta \in \Lambda(h,a,b,q))} \pi(\theta) \Big[\max(0, \mathcal{F}(\theta,k) - \overline{x}) \Big] \tag{8}$$

is the expected amount of output paid to the banks by these defaulting agents, conditional on $\mathcal{F}(\theta,k) - \overline{x} > 0$. For a loan of type (a,b) to a household of with human capital level h, the lender uses a discounting scheme, $q(h,a,b,\Lambda)$, in order to break even.[15]

Given $(1+r^f+\tau)$, the zero–profit condition for the lender of making a loan with the size qb is given by:

$$(1+r^f+\tau)qb = b(1-\sigma(h,a,b,q)) + \Omega, \tag{9}$$

where the left–hand-side of (9) is the total cost of making loans of size qb, and the right–hand-side is the sum of revenues from non–defaulting borrowers and recovered

[15] This pricing scheme is standard. For applications see Chatterjee et al. (2002), Livshits et al. (2003), and Athreya (2006).

revenues from defaulting borrowers. Expressed in terms of a premium over risk-free borrowing, we have the following fixed-point condition:

$$q(h, a, b, \Lambda) = q_l^f \left[(1 - \sigma(h, a, b, q)) + \frac{\Omega}{b} \right] \tag{10}$$

Given a loan size $bq(.)$, the discount rate is therefore increasing (i.e., q gets smaller) in the probability of default σ, and decreasing in the recovery of output beyond the exemption, $\max\{0, \mathcal{F}(\theta, k) - \overline{x}\}$. The mapping from underlying fundamentals to a "credit supply function" reveals the terms required for loans of arbitrary size, and endogenously determines borrowing as well as a credit "limit," whereby the marginal cost of borrowing goes to infinity.

It is important to emphasize that our model incorporates both secured and unsecured credit. This distinction between these two types of credit can only be made by inspecting the corresponding loan prices, i.e., $q(.)$. Notice also that if the default set $\Lambda(h, a, b, q)$ is empty, the loan is risk free, and therefore $\sigma(h, a, b, \Lambda) = 0$. This leads (10) to collapse to $q = q_l^f$. For $q < q_l^f$, the loan is risky and, therefore, at least partially unsecured. Furthermore, the above discounting scheme will result in some debt levels not being observed in equilibrium. However, off-equilibrium discount rates for some debt levels reflect the fact that, were borrowing to reach certain levels, default likelihoods would justify the rates.

Notice that limits to liability lower the ability of entrepreneurs to collateralize borrowing. In turn, ex–ante, agents react to generous exemption levels by accumulating wealth, all else equal, precisely to access secured debt.

3.3 Recursive Formulation

Let the agent's state vector be denoted $S = \{a, j, \epsilon_n^j, h\}$. Let $V(S)$ be the value attained by an agent entering a period with the state vector S. The state vector is comprised of his current level of assets a, age j, and current corporate-sector wage $\epsilon_n^j h$. Given the option over whether to be an entrepreneur or worker, $V(S)$ must satisfy

$$V(S) = \max\{V^e(S), V^w(S)\}, \tag{11}$$

where V^e denotes the option value of being an entrepreneur and V^w denotes the value of being a worker. Let $I_1(S)$ be the indicator function associated with (11). In particular, $I_1(S) = 1$ if $V^e(S) > V^w(S)$, and zero otherwise. First, we define the Bellman equations for agents of ages $j = 1, 2, ...\ J - 1$. Then, we define the Bellman equations for agents in the last period of their life, i.e. when $j = J$. We first define the value function for an entrepreneur and then we define the value function for a worker.

Entrepreneur Given an initial wealth level a, age j and a current corporate–sector wage level $\epsilon_n^j h$, the agent faces a function $q(.)$ when choosing the face of debt b optimally, which in turn determines the size of the project according to $k = a + q(h, a, b, \Lambda)b$. Therefore, the ex-ante value of choosing entrepreneurship in the current period, $V^e(S)$, is given by:

$$V^e(S) = \max_{b_j \geq 0} \{E_\theta \ W(S, b_j, \theta)\}. \tag{12}$$

Given k, the agent will act optimally for any realization of the productivity shock θ. In particular, for some realizations of the shock, the agent will choose bankruptcy and for others, will not. Let $W(S, b_j, \theta)$ be the maximal value attainable for a household of age-j whose beginning-of-period state is S, who has chosen to borrow b_j units, and who then receives productivity θ. By definition, $W(S, b_j, \theta)$ solves

$$W(S, b_j, \theta) \equiv \max \left\{ W^B(S, b_j, \theta), W^{NB}(S, b_j, \theta) \right\}. \tag{13}$$

where W^B and W^{NB} denote the values of declaring bankruptcy and not doing so, respectively.

To define the two embedded value functions W^B and W^{NB}, note first that the value of default, $W^B(S, b_j, \theta)$, depends on the size of current output $\mathcal{F}(\theta, k_j)$, which depends on the realization of θ and the current-period transactions cost for default, τ_B. Denote the price of risk-free bonds (i.e., nonnnegative savings) by $q^s \equiv \frac{1}{1+r^f}$. Letting $V(S')$ denote the expected continuation value in state S', we then have:

$$\begin{aligned}
W^B(S, b_j, \theta) \quad &= \quad \max_{a_{j+1}} \{u(c_j) + \beta_h EV(S')\} && (14)\\
\text{such that} \quad c_j + q^s a_{j+1} \quad &\leq \quad \min[\overline{x}, \mathcal{F}(\theta, k_j)] - \tau_B && (15)\\
k_j \quad &= \quad a_j + q(h, a_j, b_j, \Lambda) b_j && (16)\\
k_j > 0, \quad c_j \quad &\geq \quad 0, \quad a_{j+1} \geq 0, \quad b_j \geq 0, \quad \forall \ j = 1, \ J-1. && (17)
\end{aligned}$$

The value of not declaring bankruptcy, $W^{NB}(S, b, \theta)$, is given by:

$$\begin{aligned}
W^{NB}(S, b_j, \theta) \quad &= \quad \max_{a_{j+1}} \{u(c_j) + \beta_h EV(S')\} && (18)\\
\text{such that} \quad c_j + q^s a_{j+1} \quad &\leq \quad \mathcal{F}(\theta, k_j) - b_j && (19)\\
k_j \quad &= \quad a + q(h, a_j, b_j, \Lambda) b_j && (20)\\
k_j > 0, \quad c_j \quad &\geq \quad 0, \quad a_{j+1} \geq 0, \quad b_j \geq 0, \quad \forall \ j = 1, \ J-1. && (21)
\end{aligned}$$

Entrepreneurs of age-J solve the same discrete optimization problems in $(11)-(13)$ as entrepreneurs of other ages, with only the modification that the discounted expected continuation value is given by $\phi(.)$. Therefore, the modified objective function of an age$-J$ entrepreneur choosing bankruptcy is

$$W^B(S, b_J, \theta) = \max_{a_{J+1}}\{u(c_J) + \phi(a_{J+1})\}. \tag{22}$$

Similarly, the value of not declaring bankruptcy, $W^{NB}(S, b, \theta)$, is modified for age-J to read:

$$W^{NB}(S, b, \theta) = \max_{a_{J+1}}\{u(c_J) + \phi(a_{J+1})\}. \tag{23}$$

Worker Alternatively, the agent may choose to become a worker in the "corporate" sector, where she faces productivity risk but has access to a technology (and implicitly, a corporate capital stock) that allows her to produce the consumption good using their labor alone. To keep matters simple, we assume that workers must hold non–negative savings. For an agent choosing to be a worker in the current period, the value function is therefore given by:

$$
\begin{aligned}
V^w(S) &= \max_{a_{j+1}}\{u(c_j) + \beta EV(S')\} && (24)\\
\text{such that} \quad c_j + q^s a_{j+1} &= \epsilon_n \mu^{Corp}(j, h) + a_j && (25)\\
c_j \geq 0 \quad , &\quad a_{j+1} \geq 0, \quad \forall\ j = 1,\ J-1. && (26)
\end{aligned}
$$

If agents of age-J become workers, their value function satisfies:

$$V^w(S) = \max_{a_{J+1}}\{u(c_J) + \phi(a_{J+1})\}, \tag{27}$$

subject to the same constraints as all other workers. With the preceding value functions in hand, the original comparison to determine occupational choice, in (11), can be made for all ages $j = 1, 2, .., J$.

3.4 Equilibrium

Given the individual state space S, we can define $X = [0, \infty) \times \{1, 2, ...\ J\} \times \{\epsilon_1^j, \epsilon_2^j, ...\ \epsilon_N^j\} \times \{h_1, h_2, ...\} \times \{\theta_1, ..., \theta_N\}$. Let $(X, \mathbb{B}(X), \omega)$ be a probability space where $\mathbb{B}(X)$ is the Borel $\sigma-$algebra on X, and ω is the measure of agents on the state space. Thus, for each $\mathcal{C} \in \mathbb{B}(X)$, $\omega(\mathcal{C})$ is the fraction of agents whose individual states lie in $\mathcal{C}$. We follow Chatterjee et al. (2002) and Livshits et al. (2003) and fix the risk-free rate on savings at q^f. The individual agent's policy functions, which solve the dynamic programs in $(11)-(27)$, along with the stochastic process of endowments, induce a stochastic process for the individual's state. This process describes the evolution of occupation, borrowing, bankruptcy, and asset holdings according to a transition function $P(x, \mathcal{C}), \forall\ \mathcal{C} \in \mathbb{B}(X)$. The transition function in turn implies a stationary probability measure $\omega^*(\mathcal{C})$ for all $\mathcal{C} \in \mathbb{B}(X)$, which must satisfy the fixed point property

$$\omega^*(\mathcal{C}) = \int_X P(x, \mathcal{C}) \mathrm{d}\omega^*. \tag{28}$$

More precisely, the equilibrium is defined as follows:

Definition 2 *Given an exemption level, $\overline{x}$, a risk–free discount rate on deposits, q^f, a transaction cost on intermediation, τ, and human capital transitions across generations, $\varsigma(.)$, a recursive (partial) equilibrium for this economy consists of (i) decision rules $\{I_1(S),\ b(S),\ I_2(S; b, \theta),\ c(S; \theta),\ a'(S; \theta)\}$ for occupational choice, borrowing, bankruptcy, consumption, and savings, respectively, (ii) value functions $(11)-(27)$, and (iii) a stationary joint distribution ω^* of households over asset, wage, and productivity levels such that*

1. *Decision rules $\{I_1(S),\ b(S),\ I_2(S; b, \theta),\ c(S; \theta),\ a'(S; \theta)\}$ solve the dynamic programs in $(11)-(27)$.*

2. *Lenders make zero expected profits on each loan, i.e., the discount rate q is given by (10).*

3. *Distributions are stationary and consistent with individual optimal choices as described in (28).*

4 Parameters

We parameterize the model in order to generate outcomes consistent with observations of income, wealth, and occupational choices of US households under current US liability policy. The full list of parameters is given in Table 2, and the fit of the benchmark model is given in Figures 1, 2, and 3.

4.1 Preferences

All households have identical within-period preferences of the iso-elastic form:

$$u(c) = \begin{cases} \frac{c^{1-\xi}}{1-\xi} & \text{if } \xi > 1 \\ \log(c) & \text{if } \xi = 1 \end{cases}, \tag{29}$$

where ξ denotes the coefficient of relative risk aversion. We set ξ equal to 2, as is standard. The model period corresponds to one calendar year and our benchmark calibration sets $\beta_h = \{0.985, 0.970\}$ for college and non-college agents, respectively. We parameterize the retirement-wealth valuation function such that it has the identical form, i.e.,

$$\phi(a_{J+1}) = \psi_h \frac{a_{J+1}^{1-\rho}}{1-\rho} \tag{30}$$

which, given wealth accumulation patterns during working life, allows us to approximate median wealth among 65-year-old households while eliminating an additional free parameter. We calibrate the human capital–specific parameter ψ_h, and set $\psi_h = \{\psi_c, \psi_{hs}\} = \{15, 7.5\}$ for skilled and unskilled agents respectively. We also set the other free parameter $\rho = 2$ to meet our calibration targets.

4.2 Labor Productivity

Our model partitions the population by human capital levels and occupational choices and, therefore, we closely follow Mondragon (2006) in setting targets. A natural partition for human capital is to allow for two levels of human capital, representing college–educated and high–school educated (non–college) households, respectively. That is, $h = \{h_c, h_{hs}\}$. In what follows we use the terms “skilled” and “unskilled” interchangeably with “college-educated”, and “high-school-educated,” respectively. Terajima (2004) measures the fraction of college-educated households to be 35%, and the high-school educated population at 65%. We match these proportions by assuming that each child of a college-educated parent attains collegiate education with probability 0.61, and that each child of the non-college-educated attains collegiate education with probability 0.21. That is, we set $\varsigma(h' = h_c | h = h_c) = 0.61$ and $\varsigma(h' = h_c | h = h_{hs}) = 0.21$.

In terms of the age- and skill-specific path of life-cycle productivity, $\mu^{Corp}(j, h)$, we set productivity for college-educated workers by linear interpolation of the estimates of Hansen (1993). Because agents are assumed to know the corporate sector productivity prior to choosing self-employment, we will not observe the entire range of such shocks. Rather, those with particularly low current corporate productivity might exercise the option of self-employment. Therefore, we set the mean age-profile of high-school educated households $\mu^{Corp}(j, h_{hs})$ such that in equilibrium, we match the average skill premium, *given the self-selection of households into the corporate sector*. For the volatility of corporate sector productivity risk, we set the standard deviation of shocks to approximate the unconditional cross-sectional variance of log-earnings as estimated by Hansen (1993) and others.

4.3 Entrepreneurial Production

To parameterize entrepreneurial production, we first follow Polkovnichenko (2003) and assume that the level of human capital is not occupation–specific and, therefore, does not depreciate if the agent enters into or exits from entrepreneurship. For the entrepreneurial production technology, we set $\mathcal{F}(\theta, k) \equiv \theta k^{\gamma} + (1-\delta)k$.

The production parameter γ is common to all entrepreneurial ventures, and is set to 0.75, close to the value in Cagetti and De Nardi (2006). A common returns–to–scale parameter allows us to isolate the tension between the insurance provision and credit limits created by the ability to shelter wealth while repudiating debts. We set the effective depreciation rate, $\delta = 0.11$, in line with standard values.

To parameterize production risk, θ, we follow Davis and Willen (2002) and impose zero correlation between the corporate–sector and entrepreneurial–sector productivity. The distribution of shocks to the entrepreneurial project varies across human capital types. The logarithm of θ is given for college-educated households by an intertemporally, and cross-sectionally, i.i.d. normal random variable with mean $\mu_{\theta_c} = -1.35$ and standard deviation $\sigma_{\theta_c} = 0.83$. For high-school educated households, we have $\mu_{\theta_{hs}} = -1.44$, and $\sigma_{\theta_{hs}} = 0.83$. This parameterization allows us to closely match the respective sizes of the populations of low and high human capital workers and entrepreneurs, as well as their relative income and wealth.[16]

4.4 Credit Markets and Bankruptcy

With respect to the costs of borrowing and the returns to saving, we set the risk-free rate $(1 + r^f) = 1.04$, following Mehra and Prescott (1985), which implies a price on savings of approximately $q^s = 0.96$. With respect to costs of bankruptcy, to capture various fees and court costs associated with the actual bankruptcy filing procedure, we assign $\tau_B = 0.15$, which corresponds to roughly \$7,500, given the total of legal fees, court costs, and other miscellaneous expenses as documented, e.g., in Caher and Caher (2003).

In order to set the target for default in the model, we proceed as follows. First, Lawless and Warren (2005) report that up to 20% of bankruptcy filings are attributable to the self-employed, even though their population share has been measured to be as low as 7%. By contrast, in the overall population, the Chapter 7 bankruptcy rate (the form the model most closely represents) has, over the past decade, averaged approximately 1.25% of U.S. households annually (see American Bankruptcy Institute: www.abiworld.org).

[16]For computation, we discretize the distribution of shocks, following the procedure of Tauchen (1986), into seven values.

However, as Sullivan et al. (1989) argue, the disproportionate share of entrepreneurs in the pool of bankrupt individuals may be underestimated in the data. Some individuals list current occupations in categories that suggest that they are currently wage earners, but list significant amounts of debt for capital equipment, suggesting self-employment.[17] Our target, in turn, follows Sullivan et al. (2000), who suggest that the self-employed file roughly twice as frequently as the general population. Given the range of estimates, we target a default rate between 1% and 2.5%. In addition to using bankruptcy more frequently, the self-employed also discharge much more debt per filing than other groups in the population. For debt discharged in bankruptcy, we note that Sullivan et al. (2000) argue the self-employed discharge roughly twice as much debt as the mean amount discharged by working households. However, the fact that the self-employed may well file for default after exiting their business means that the unconditional mean debt discharged will be informative as well. These considerations lead us to target mean debts discharged in default in the range of $20,000 to $50,000.

4.5 Limits to Liability

Our central experiment is to study the role played by limited liability on the ability and willingness of households to enter self-employment. The structure of limited liability in the model is motivated most directly by provisions in US personal bankruptcy laws that determine the total wealth that a household may retain ex-post bankruptcy. We select a benchmark level of approximately $50,000 (Rodríguez et al., 2002). This benchmark captures the median exemption level prevailing in the US, as measured in Athreya (2006). This benchmark is then compared against four alternative exemption levels ranging in dollar value from $2,500 to $150,000.[18]

[17]For example, Sullivan et al. (2000) note the presence of many who describe themselves as "cooks" or "restaurant managers," and then list restaurant equipment as assets.

A second problem in measuring bankruptcy among entrepreneurs is that households can, and do, switch occupations. In particular, some who report themselves to be workers when filing for bankruptcy may have accumulated debt during their past activity as an entrepreneur. Using the data from Survey of Consumer Finance, Rodríguez et al. (2002) reports that the probability of being an entrepreneur conditional being a bankrupt household is only 5.4%. However, there is a one year lag between the filing for bankruptcy and the response to the SCF.

[18]While statutorily, some states in the US have no limits on the wealth that might be exempted, especially home equity, in practice there are limits. These limits include limits to the size of parcels of land on which houses sit and the value of homes themselves. Our upper bound corresponds to allowing households to exempt all wealth up to the value of the median US house as of 2002.

4.6 Fit of the Benchmark Model

Our benchmark calibration is able to capture very well nearly all of the preceding targets. In particular, the model predicts well not only the occupational distribution of US households, but also their relative earnings, as well as the observed age-profile of self-employment. Figures 1 and 3 display benchmark outcomes relative to their empirical counterparts. With respect to default rates and debts discharged in default, Table 3 shows that the default rate in the benchmark case (i.e., $\overline{x}_3$) is 1.53%, while Table 4 shows that the mean debt discharged in default is \$30,627.

5 Results

Our central finding is that the tension between the insurance embedded in limited liability, and the incentive effects arising from higher credit costs is resolved initially in favor of insurance provision. However, at levels of liability exceeding current US levels, the impact of limited liability is to decisively increase credit costs, limit credit use, and in general, obstruct self-employment. We also show, strikingly, that the observed positive correlation between wealth and self-employment cannot be interpreted as evidence of credit constraints, as it arises primarily from the interaction of risk and life-cycle savings behavior. Distributionally, three findings are important. First, limited liability appears regressive with respect to age. We find that very low liability sharply affects the young, but has only minor effects on the old, who have accumulated wealth for retirement. Second, in contrast to its effects on age, liability policy does not appear to affect high- and low-skilled households differentially. Third, our findings suggest that very low-liability regimes significantly alter the ability of households to switch occupations in the event of low corporate sector productivity.

Turning first to the effects of liability policy on the "extensive" margin of self-employment, our results are as follows. First, and most importantly, liability policy appears to be relevant for the aggregate rate of self-employment, as reported in Table 3. As liability is decreased from its highest levels, $\overline{x}_1$, to its lowest level, $\overline{x}_5$, the aggregate entrepreneurship rate decreases by more than two percentage points, from 11.41% to 9.38%. However, this decrease is not monotone. Notably, as limits to liability fall from the $\overline{x}_1$ to $\overline{x}_2$, the self-employment rate rises slightly for both skilled and unskilled households. The initial increase in self-employment occurs despite an increase in the cost of obtaining credit. Figure 6 makes clear that decreases in liability always result in more expensive credit. The increased cost of credit has several effects. First, at the "extensive" margin, the fraction of borrowers falls slightly, and monotonically, from 51.88%

to 49.19%, as liability falls from $\overline{x}_1$ to $\overline{x}_5$. However, the effects on the "intensive" margin, i.e., the size of debts are much more dramatic and non-monotone. Unconditionally, the mean level of borrowing initially increases by roughly 5%, from \$61,513 to \$65,089, in a move from $\overline{x}_1$ to $\overline{x}_2$. Subsequent decreases in borrower liability lower borrowing very sharply. In particular, moving from $\overline{x}_2$ to $\overline{x}_5$ results in a fall of mean borrowing to \$6,962. This is clear evidence that while limited liability can generate offsetting effects at low levels, at high levels, credit use is severely restricted.

Do the changes in credit use ultimately affect the size of projects undertaken? From Table 4 we see that as with the rate of self-employment, project size too is "hump-shaped." Initially, moving from $\overline{x}_1$ to $\overline{x}_2$ increases the scale of projects slightly. Further decreases in liability, however, have much stronger effects. Notably, mean project size under $\overline{x}_5$ is approximately 15% smaller than its peak value, which occurs under $\overline{x}_1$ to $\overline{x}_2$. Therefore, even though the fraction of borrowers and entrepreneurs changes only modestly with exemption, the most important effects of liability policy occur along the "intensive" margin, substantially modifying borrowing and, in turn, project size.

The relatively large changes in borrowing and project size are due to sharp increases in the cost of credit faced by individuals. However, these changes, even though critical for household decision making, will not be observed in the data. Table 5 shows that the average interest rate paid by borrowing varies only slightly with limits to liability. In particular, the average interest rate increases from 6.25% under $\overline{x}_1$, to 6.68%, under $\overline{x}_3$, and then *decreases* to 6.26%, under $\overline{x}_5$. The insensitivity of interest rates to liability is evidence that equilibrium default risk is also essentially invariant to liability policy. Notice that default risk, as embedded in loan pricing, increases monotonically as liability falls. Nontheless, default rates in equilibrium make clear that it is borrowing that becomes limited to such an extent at low levels of liability that default is rarely observed.

Notice that a reduced-form regression of equilibrium interest rates and measures of liability will imply, wrongly, that the cost of credit is insensitive to liability policy. Using such a conclusion to recommend decreases in liability will have the unintended consequence of discouraging credit use and, in turn, self-employment. Similarly, the observation that bankruptcy is infrequently used under low personal liability for debts does not imply that such a policy will have only benign effects on credit provision. Our equilibrium approach demonstrates directly that liability policy has important "off-equilibrium" effects on credit pricing that in turn strongly affect outcomes.

In a setting with limited liability, wealth accumulation serves two puposes. First, for any given loan size, a higher level of wealth implies a lower default probability and, in turn, a lower interest rate. Second, households can operate self-employment projects without having to resort to external finance. As before, reductions in liability from very high levels, such as a move from $\overline{x}_1$ to $\overline{x}_2$, lower the average wealth of those who borrow. In this particular case, the average wealth of the self-employed borrower falls from \$83,431 to \$81,721. Further decreases in liability, however, leave households unwilling to borrow. In turn, for levels of liability below $\overline{x}_2$, the wealth position of borrowers increases sharply, up to \$96,458 under $\overline{x}_5$. A similar outcome is seen in the debt-to-capital ratio of self-employment projects. Initially, this ration increases slightly, from 22.36% to 22.64%, but then drops dramatically to just 3.55% under the lowest liability level. That is, external finance becomes far less important in the funding of self-employment.

Under very low liability levels, the reliance of households on internal finance systematically increases the average age of the self-employment households. In short, wealth takes time to accumulate. As Table 3 shows, the average age of the self-employed increases substantially from 30.60 years of age to 33.01. The top panel of Figure 4 shows that the entire age-distribution of the self employed shifts to the "right." Notice from the figure that while lower liability increases the age of self-employed households, these effects are very muted prior to retirement. This is very natural and an important implication of the life cycle. That is, as retirement wealth accumulation leaves most older households with the ability to internally finance self-employment, the latter are relatively less sensitive to liability policy on debts.

The preceding makes clear that low liability does introduce credit constraints that materially alter the timing of self-employment activity. Notice from the bottom panel of Figure 4, however, that the wealthy always choose self–employment at higher rates, *regardless* of liability policy. In particular, the result obtains under the nearly unlimited liability level $\overline{x}_1$, where households can commit to repaying debts in for almost all realizations of entrepreneurial productivity. As seen in Figure 6, almost all households are able to borrow very large amounts at the risk-free rate. Thus, the observed correlation of wealth and entrepreneurship (see, e.g., Hurst and Lusardi (2004)) is fundamentally uninformative about the presence, or extent, of liquidity constraints. Instead, the risks inherent in self-employment, along with the life-cycle accumulation of wealth deliver a positive correlation between wealth and self-employment.[19]

As mentioned at the outset, our model allows us to see what econometricians cannot, and thereby view the precise nature of the self-selection of households into and out of self-employment. We illustrate the role of liability policy on the ability of households to enter self-employment in "response" to a low realization of corporate-sector productivity. Occupational choices in our model depend on wealth and corporate-sector productivity. To isolate the effect of corporate-sector productivity, we first display, in

[19]See also Mondragon (2006) for a closely related argument.

Figure 5, the probability of entrepreneurship as a function of productivity, conditional on wealth. In the top panel of the figure, we observe that among low-wealth households, high levels of liability are associated with relatively high incidence of self-employment when the outside option to self-employment is poor. This suggests that the relatively inexpensive credit available under high liability offers those with low corporate-sector productivity the "safety-valve" of entry into self-employment. However, as household wealth increases, the extent to which liability alters occupational choice diminishes. This is seen in the middle and bottom panels of the same figure.

In order to evaluate the welfare implications of liability choice, we focus on the ex-ante indirect utility of a newly-working household. As all households begin life with zero assets in our model, this criterion avoids complications arising from changes in the wealth distribution that would bias results arising from expected steady-state welfare. Even though changes in liability policy induce noticeable changes in the timing, size, and financing, of self-employment projects, a surprising finding is that the ex-ante welfare of a newborn household is essentially invariant to the regime chosen. The intuition is as follows. At high levels of liability (e.g., $\overline{x}_1$ and $\overline{x}_2$), the insurance benefits of limiting liability offset the disincentives to self-employment induced by costly credit. By contrast, at very low levels of liability (e.g., $\overline{x}_4$ and $\overline{x}_5$), the ability to self-finance via risk-free savings functions effectively to undo the complications arising from high credit costs. The latter is seen most clearly in the increased mean age of the self-employed under low-liability regimes.

6 Conclusion

The main message of this paper is that the limits to liability alter the timing, size, and financing of self-employment projects, especially at levels that are high relative to current US practice. High liability, by contrast, appears to generate offsetting effects. Namely, while cheap credit encourages self-employment, the absence of a generous default option makes such a choice risky. In low liability regimes, while the cost of credit dominates the insurance benefits, the flexibility of households to switch occupations and save to overcome high borrowing costs leads to nearly identical allocations. As a result, welfare remains largely unchanged. We also find that the positive relationship between wealth and self-employment rates cannot be seen as evidence for credit constraints. In particular, we show that such a relationship is present even when limited liability is eliminated.

It is useful to note that our current approach employs inelastic labor and homogeneous risk for self-employment projects. To the extent that availability of limited liability discourages effort, the disincentive effects may be larger than measured here. Similarly, the insurance provision of limited liability via default may lead households, if allowed, to choose projects that are inefficiently risky. While beyond the scope of the current study, these dimensions are worthy of further investigation.

References

Albuquerque, R., and Hopenhayn, H., 2004. "Optimal Lending Contracts and Firm Dynamics." *Review of Economic Studies* 71, 285-315.

Athreya, K.B., 2006. "Fresh Start or Head Start? Uniform Bankruptcy Exemptions and Welfare." *Journal of Economic Dynamics and Control* 30, 2051–2079.

Banerjee, A.V., and Newman, A.F., 1991. "Risk–Bearing and the Theory of Income Distribution." Review of Economic Studies 58, 211-235.

Berkowitz, J., and White, M., 2004. "Bankruptcy and Small Firms' Access to Credit." *RAND Journal of Economics* 35, 69-84.

Cagetti, M. and DeNardi, M., 2006. "Entrepreneurship, frictions, and wealth." *Journal of Political Economy* 114, 835-870.

Caher, J., and Caher, J., 2003. *Personal Bankruptcy Laws For Dummies.* Wiley Publishing, New York, NY.

Chatterjee, S., Corbae, D., Nakajima, M., and Ríos-Rull, J., 2002. "A Quantitative Theory of Unsecured Consumer Credit with Risk of Default." Federal Reserve Bank of Philadelphia, working paper 02-6.

Cullen, J. B., and Gordon, R., 2002. "Taxes and Entrepreneurial Activity: Theory and Evidence for the U.S." UC-San Diego, working paper.

Davis, S., and Willen, P., 2002. "Using Financial Assets to Hedge Labor Income Risk: Estimating the Benefits." University of Chicago, mimeo.

Davis, S., Kubler, F., and Willen, P., 2005. "Borrowing Costs and the Demand for Equity over the Life Cycle." *forthcoming in The Review of Economica and Statistics.*

Elul, R., and Subramanian, N., 2002. "Forum–Shopping and Personal Bankruptcy." *Journal of Financial Services Research* 21, 233–255.

Evans, D., and Jovanovic, B., 1989. "An Estimated Model of Entrepreneurial Choice under Liquidity Constraints." Journal of Political Economy 97, 808-827.

Evans, D., and Leighton, L. 1989. "Some Empirical Aspects of Entrepreneurship." *American Economic Review* 79, 519-535.

Evans, D., and Schmalensee, R., 1999. Paying with Plastic. Cambridge, MA: MIT Press.

Fairlie, R., and Krashinsky, H., 2006. "Liquidity Constraints, Household Wealth, and Entrepreneurship Revisited ." working paper, UC–Santa Cruz.

Farber, H., 1999. "Alternative and Part–Time Employment Arrangements as a Response to Job Loss." *Journal of Labor Economics* 17, S142-S169.

Fan, W., and White, M., 2003. "Personal Bankruptcy and the Level of Entrepreneurial Activity." *Journal of Law & Economics* 46, 543-568.

Fay, S., Hurst, E., White, M. 2002. "The Household Bankruptcy Decision." *American Economic Review* 92, 706-718.

Georgellis, Y., and Wall, H., 2004. "Entrepreneurship and Policy Environment." working paper, Federal Reserve Bank of St. Louis.

Gropp, R., Scholz, J. K., and White, M., 1997. "Personal Bankruptcy and Credit Supply and Demand." *Quarterly Journal of Economics*, CXII, 217-252.

Hamilton, B., 2000. "Does Entrepreneurship Pay? An Empirical Analysis of the Returns to Self-Employment." *Journal of Political Economy* 108, 604-631.

Hansen, G.D., 1983. "The Cyclical and Secular Behavior of the labor Input: Comparing Efficiency Units and Hours Worked," *Journal of Applied Econometrics* 8, 71-80.

Heathcote, J., Storesletten, K., and Violante, G., 2005. "Two Views of Inequality." *Journal of European Economic Association Paper and Proceedings, forthcoming.*

Holtz-Eakin, D., Joulfaian, D., and Rosen,H., 1994. "Sticking it Out: Entrepreneurial Survival and Liquidity Constraints." Journal of Political Economy 102, 53-75.

Hopenhayn, H., and Vereshchagina, G., 2005. "Risk Taking by Entrepreneurs." University of Iowa, working paper.

Huckfeldt, G. L., 1991. "Conversion of Non-exempt Assets to Exempt Assets Prior to Bankruptcy." Missouri Law Review 56, 857-868.

Hurst, E., and Lusardi, A., 2004. "Liquidity Constraints, Household Wealth and Entrepreneurship." Journal of Political Economy 112, 319-347.

İmrohoroğlu, A., 1989. "Costs of Business Cycles with Indivisibilities and Liquidity Constraints." *Journal of Political Economy* 97, 1364-1383.

İmrohoroğlu, A., 1992. "The Welfare Cost of Inflation under Imperfect Insurance." *Journal of Economic Dynamics and Control* 16, 79-91.

Krasa, S., Sharma, T., and Villamil, A., 2004. "Bankruptcy and Firm Finance." Working paper, University of Illinois, and ITAM.

Lawless, R., and Warren, E., 2005. "The Myth of the Disappearing of the Business Bankruptcy." forthcoming in *California Law Review*.

Lazear, E., 2005. "Entrepreneurship." *Journal of Labor Economic* 23, 649–680.

Livshits, I., MacGee, J., and Tertilt, M., 2003. "Consumer Bankruptcy: A Fresh Start." Federal Reserve Bank of Minneapolis, workig paper 617.

Meh, C., 2005. "Entrepreneurship, Wealth Inequality, and Taxation." *Review of Economic Dynamics* 8, 688-719.

Meh, C., and Terajima, Y., 2005. "Housing, Personal Bankruptcy, and Entrepreneurship." Bank of Canada Working paper.

Mehra, R., and Prescott, E., 1985. "The Equity Premium: A Puzzle." *Journal of Monetary Economics* 15, 156-162.

Mondragan, C, 2006, "The Transition to Entrepreneurship: Human Capital, Wealth, and the Role of Liquidity Constraints", mimeo, Georgetown University.

Moss, D. A., 2002. *When All Else Fails: Government as the Ultimate Risk Manager.* Cambridge: Harvard University Press.

Polkovnichenko, V., 2003. "Human capital and Private Equity Premium." *Review of Economic Dynamics* 6, 831-845.

Posner, E., Hynes, R., and Malani, A., 2001. "The Political Economy of Property Exemption Laws." The Law School at the University of Chicago, working paper.

Quadrini, V., 2000."Entrepreneurship, Saving, and Social Mobility." *Review of Economic Dynamics* 3: 1-40.

Quintin, E. 2003. “Limited Enforcement and the Organization of Production.” working paper, Federal Reserve Bank of Dallas.

Rissman, E., 2003. “Self–Employment as an Alternative to Unemployment.” Working paper, Federal Reserve Bank of Chicago.

Rissman, E., 2006. “The Self–Employment Duration of Younger Men over the Business Cycle.” *Federal Reserve Bank of Chicago Economic Perspectives* 3Q, 14-27.

Rodríguez, S. B., Díaz-Giménez, J., Quadrini, V., Ríos-Rull, J., 2002. “Updated Facts on the U.S. Distributions of Earnings, Income, and Wealth.” *Federal Reserve Bank of Minneapolis Quarterly Review* 26, 2-35.

Rosen, H., and Willen, P., 2002. “Risk, Return, and Self-Employment.” Working paper, Federal Reserve Bank of Boston.

Skeel, D. A., 2001. Debt’s Dominion: A History of Bankruptcy Law in America. Princeton University Press, Princeton, NJ.

Sullivan, T., Warren, E., and Westbrook, J., 1989. *As We Forgive Our Debtors.* Oxford Univ Press; New York, NY.

Sullivan, T., Warren, E., and Westbrook, J., 2000. *The Fragile Middle Class: American in Debt.* Yale University Press, New Haven, CT.

Tauchen, G., 1986. “Finite State Markov Chain Approximations to Univariate and Vector Autoregressions.” *Economic Letters* 20, 177-181.

Terajima, Y. 2004. “Education and Self-Employment: Relationships between Earnings and Wealth Inequality.” mimeo.

The Economist, October 18, 2006. *Not so down and out.*

Zame, W.R., 1993. “Efficiency and the Role of Default when Security Markets and Incomplete.” American Economic Review 83, 1142-1164.

Zha, T., 2001. “Bankruptcy Law, Capital Accumulation, and Aggregate Effects: A Dynamic Heterogenous Agent Model with Incomplete Markets.” *Annals of Economics and Finance* 2, 379-400.

APPENDIX

We provide the proof of the theorem in the paper.

Proof. Taking the partial derivative of (1) with respect to $\overline{x}$, using the Leibniz rule, we get the following:

$$\begin{aligned}\frac{\partial V(D,\overline{x})}{\partial \overline{x}} &= \pi(\theta_1)u\Big(f(D,\theta_1)\Big)\frac{\partial \theta_1}{\partial \overline{x}} + u'(\overline{x})\int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})}\pi(\theta)d\theta \\ &+ u(\overline{x})\pi(\theta_2)\frac{\partial \theta_2}{\partial \overline{x}} - u(\overline{x})\pi(\theta_1)\frac{\partial \theta_1}{\partial \overline{x}} \\ &+ \int_{\theta_2(\overline{x})}^{\overline{\theta}} u'(f(D,\theta) - R(\overline{x})D)\Big(-\frac{\partial R(\overline{x})}{\partial \overline{x}}\Big)D\pi(\theta)d\theta \\ &- u(f(D,\theta_2) - R(\theta_2)D)\pi(\theta_2)\frac{\partial \theta_2}{\partial \overline{x}} \quad . \end{aligned} \tag{31}$$

Notice that, by definition, when $\theta = \theta_1$, we have $\overline{x} = f(\theta_1, D)$. Similarly, when $\theta = \theta_2$, we have $\overline{x} = f(\theta_2, D) - R(\overline{x})D$. Thus, (31) reduces to

$$\frac{\partial V(D,\overline{x})}{\partial \overline{x}} = u'(\overline{x})\int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})}\pi(\theta)d\theta - \int_{\theta_2(\overline{x})}^{\overline{\theta}} u'(f(D,\theta) - R(\overline{x})D)\Big(\frac{\partial R(\overline{x})}{\partial \overline{x}}\Big)D\pi(\theta)d\theta \quad . \tag{32}$$

The lender must still break even after the change in $\overline{x}$. Thus, using (2), and taking the partial derivative we get:

$$\begin{aligned}\frac{\partial R^f D}{\partial \overline{x}} &= \frac{\partial}{\partial \overline{x}}\Bigg[0\int_{\underline{\theta}}^{\theta_1(\overline{x})}\pi(\theta)d\theta + \int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})}(f(D,\theta) - \overline{x})\pi(\theta)d\theta + R(D,\overline{x})D\int_{\theta_2(\overline{x})}^{\overline{\theta}}\pi(\theta)d\theta\Bigg] \\ 0 &= -\int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})}\pi(\theta)d\theta + (f(\theta_2,D) - \overline{x})\pi(\theta_2)\frac{\partial \theta_2}{\partial \overline{x}} - (f(\theta_1,D) - \overline{x})\pi(\theta_1)\frac{\partial \theta_1}{\partial \overline{x}} \\ &+ \int_{\theta_2(\overline{x})}^{\overline{\theta}}\frac{\partial R(\overline{x})}{\partial \overline{x}}D\pi(\theta)d\theta - \pi(\theta_2)R(\overline{x})D\frac{\partial \theta_2}{\partial \overline{x}}. \end{aligned} \tag{33}$$

Similarly, since $\overline{x} = f(\theta_1, D)$ and $\overline{x} = f(\theta_2, D) - R(\overline{x})D$, (33) reduces to:

$$0 = -\int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})}\pi(\theta)d\theta + \int_{\theta_2(\overline{x})}^{\overline{\theta}}\frac{\partial R(\overline{x})}{\partial \overline{x}}D\pi(\theta)d\theta, \tag{34}$$

which further implies that

$$\frac{\partial R(\overline{x})}{\partial \overline{x}}D = \frac{\int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})}\pi(\theta)d\theta}{\int_{\theta_2(\overline{x})}^{\overline{\theta}}\pi(\theta)d\theta}. \tag{35}$$

Substituting (35) into (32), we get

$$\frac{\partial V(D,\overline{x})}{\partial \overline{x}} = u'(\overline{x}) \int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})} \pi(\theta)d\theta - \frac{\int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})} \pi(\theta)d\theta}{\int_{\theta_2(\overline{x})}^{\overline{\theta}} \pi(\theta)d\theta} \int_{\theta_2(\overline{x})}^{\overline{\theta}} u'(f(D,\theta) - R(\overline{x})D)\pi(\theta)d\theta \quad , \tag{36}$$

which can be re-arranged

$$\frac{\partial V(D,\overline{x})}{\partial \overline{x}} = \int_{\theta_1(\overline{x})}^{\theta_2(\overline{x})} \pi(\theta)d\theta \left[u'(\overline{x}) - \frac{1}{\int_{\theta_2(\overline{x})}^{\overline{\theta}} \pi(\theta)d\theta} \int_{\theta_2(\overline{x})}^{\overline{\theta}} u'(f(D,\theta) - R(\overline{x})D)\pi(\theta)d\theta \right] \quad , \tag{37}$$

Notice, however, since $u''(.) < 0$, we have

$$u'(\overline{x}) = \frac{\int_{\theta_2(\overline{x})}^{\overline{\theta}} u'(\overline{x})\pi(\theta)d\theta}{\int_{\theta_2(\overline{x})}^{\overline{\theta}} \pi(\theta)d\theta} > \frac{\int_{\theta_2(\overline{x})}^{\overline{\theta}} u'(f(D,\theta) - R(\overline{x})D)\pi(\theta)d\theta}{\int_{\theta_2(\overline{x})}^{\overline{\theta}} \pi(\theta)d\theta}$$

This completes the proof. ■

Table 1: Sequence of Events in a Given Period

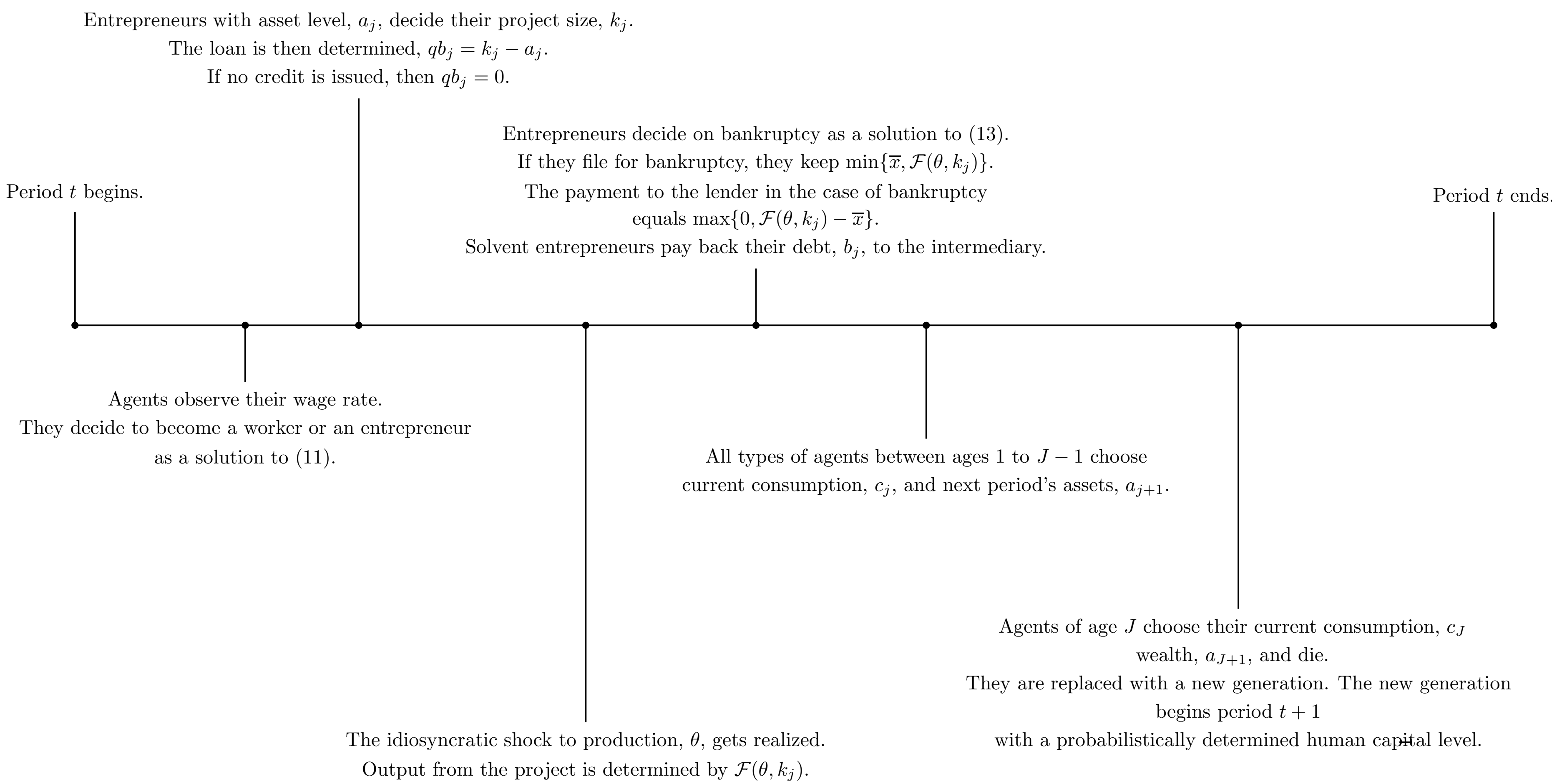

Table 2: **Parameters**

Preferences

$\{\beta_c, \beta_{hs}\}$	$\{0.985,0.970\}$	calibrated
$u(c) = \frac{c^{1-\xi}}{1-\xi}$	$\xi = 2$	calibrated.
$\phi(a_{J+1}) = \psi_h \frac{a_{J+1}^{1-\rho}}{1-\rho}$	$\rho = 2$, $\psi_h = \{\psi_c, \psi_{hs}\} = \{15, 7.5\}$	calibrated.

Labor Productivity

$h = \{h_c, h_{hs}\}$	$\varsigma(h' = h_c \vert h = h_c) = 0.61$,	
	$\varsigma(h' = h_c \vert h = h_{hs}) = 0.21$	calibrated.
$\mu^{Corp}(j, h)$	calibrated	Hansen (1993).

Entrepreneurial Production

$\mathcal{F}(.) \equiv \theta k^{\gamma} + (1-\delta)k$	$\gamma = 0.75, \delta = 0.11$	calibrated.
$\log\theta \sim N(\mu_{\theta_h}, \sigma_{\Theta_h})$	$\mu_{\Theta_c} = -1.35$, $\sigma_{\Theta_c} = 0.83$.	
$h = \{c, hc\}$	$\mu_{\Theta_{hs}} = -1.44$, $\sigma_{\Theta_{hs}} = 0.83$.	calibrated.

Credit Markets

q^f	0.96	Mehra and Prescott (1985).
τ	0.0225	calibrated
τ_B	$0.15 \approx \$7{,}500$.	calibrated.
η	0.8	calibrated.

Exemptions

$\overline{x} = \{\overline{x}_1, \overline{x}_2, \overline{x}_3, \overline{x}_4, \overline{x}_5\}$	$\overline{x} = \{2,500, 25,000, 50,000, 100,000, 150,000.\}$	
in dollars	$\overline{x}_{bench} = \overline{x}_3 = \$50,000$.	calibrated.

Table 3: Aggregates – Extensive Margin

	$\overline{x}_1$	$\overline{x}_2$	$\overline{x}_3$	$\overline{x}_4$	$\overline{x}_5$
Entrepreneurship	11.41%	11.64%	10.20%	9.29%	9.38%
Entrepreneurship High Sch	9.67%	9.73%	8.03%	7.16%	7.43%
Entrepreneurship College	14.84%	15.40%	14.47%	13.48%	13.23%
Bankruptcy Rate	0.00%	1.30%	1.53%	0.29%	0.00%
Bankruptcy Rate High Sch	0.00%	0.68%	0.74%	0.00%	0.00%
Bankruptcy Rate College	0.00%	2.53%	3.09%	0.85%	0.00%
Prob of Borrowing	51.88%	51.47%	50.24%	50.29%	49.19%
Prob of Borrowing High Sch	58.60%	56.98%	54.93%	58.35%	56.17%
Prob of Borrowing College	38.65%	40.62%	41.01%	34.41%	35.43%
Mean Age of Entrepreneurs	30.60	30.89	32.28	33.16	33.01
Mean Age of HS Entreps	30.87	30.41	31.35	32.94	32.57
Mean Age of Coll Entreps	30.46	31.14	32.75	33.27	33.23

Table 4: Aggregates – Intensive Margin

	$\overline{x}_1$	$\overline{x}_2$	$\overline{x}_3$	$\overline{x}_4$	$\overline{x}_5$
Project Size uncon.	$179,936	$182,486	$179,709	$160,113	$159,376
Project Size High Sch.	$151,802	$156,408	$150,674	$124,662	$128,906
Project Size College	$235,348	$233,848	$236,896	$229,935	$219,389
Mean Wealth |Borr.	$83,431	$81,721	$90,998	$93,560	$96,458
Mean Wealth |Borr, Hs	$69,943	$69,178	$78,451	$77,007	$79,127
Mean Wealth |Borr, Coll	$109,997	$106,425	$115,711	$126,162	$130,594
Average Debt uncon.	$61,513	$65,089	$50,368	$18,379	$6,962
Average Debt High Sch.	$53,268	$55,383	$38,438	$8,665	$5,827
Average Debt College	$77,751	$84,205	$73,865	$37,509	$9,197
Debt Discharged uncon.	$0	$38,054	$30,627	$0	$0
Debt Discharged HS	$0	$25,973	$18,375	$0	$0
Debt Discharged Coll.	$0	$61,848	$54,759	$0	$0

Table 5: Limited Liability, Borrowing, and Cost of Credit

	$\overline{x}_1$	$\overline{x}_2$	$\overline{x}_3$	$\overline{x}_4$	$\overline{x}_5$
Debt-to-Capital unc.	22.36%	22.64%	16.52%	6.11%	3.55%
Debt-to-Capital HS	16.32%	18.05%	15.46%	7.19%	2.33%
Debt-to-Capital Coll	25.43%	24.98%	17.06%	5.55%	4.17%
Interest Rate unc.	6.25%	6.62%	6.68%	6.34%	6.26%
Interest Rate HS	6.25%	6.43%	6.47%	6.26%	6.25%
Interest Rate Coll	6.25%	6.99%	7.09%	6.50%	6.27%

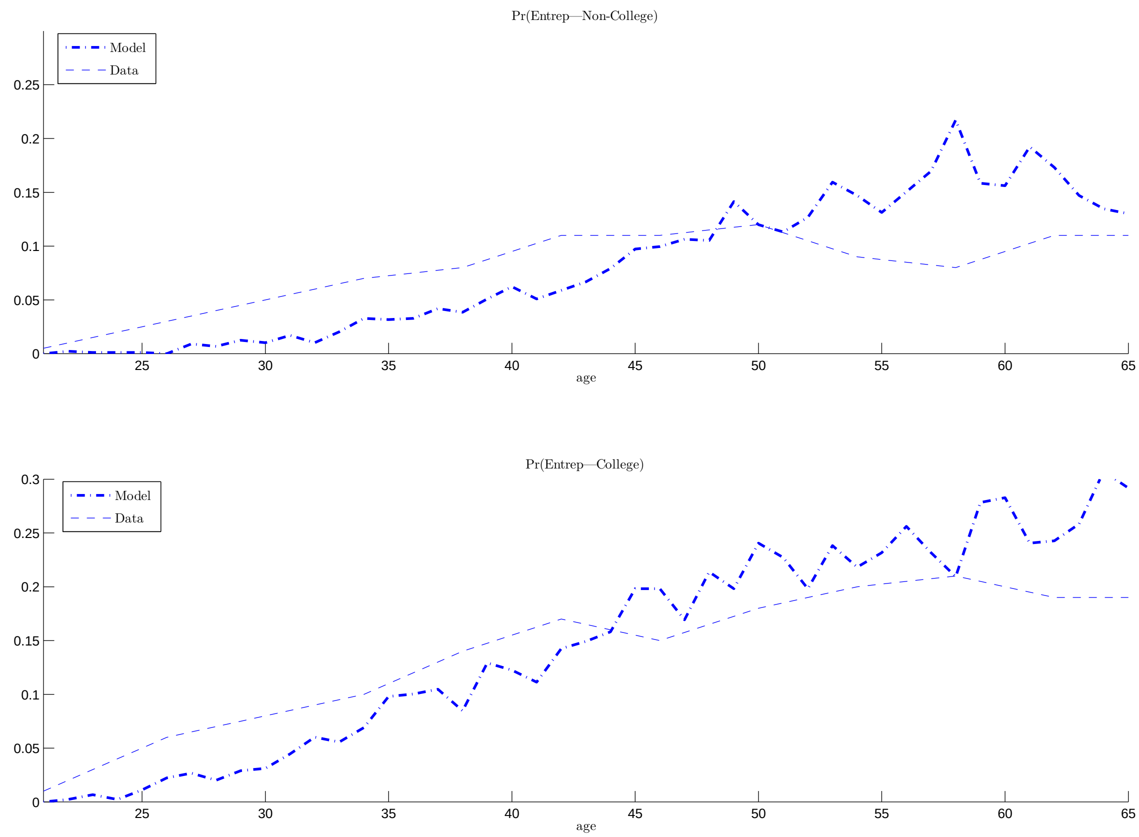

Figure 1: Age Distribution of Self–Employment Rate

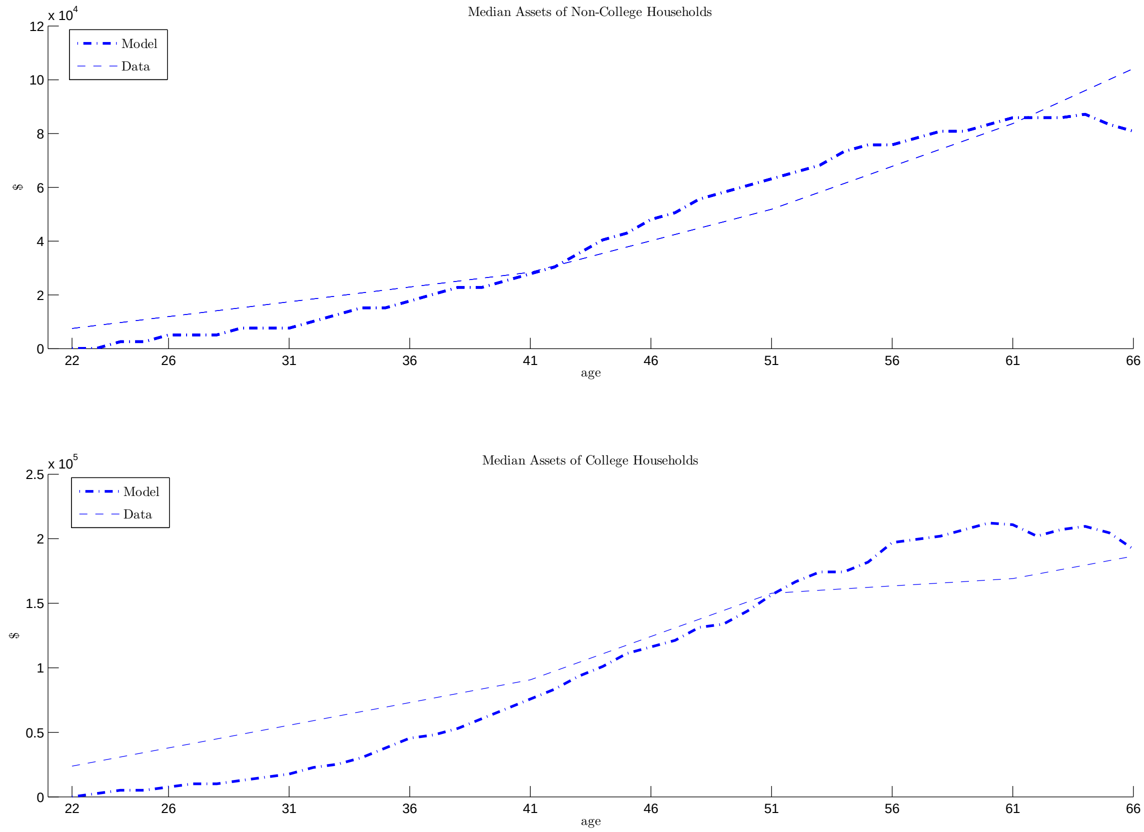

Figure 2: Median Wealth

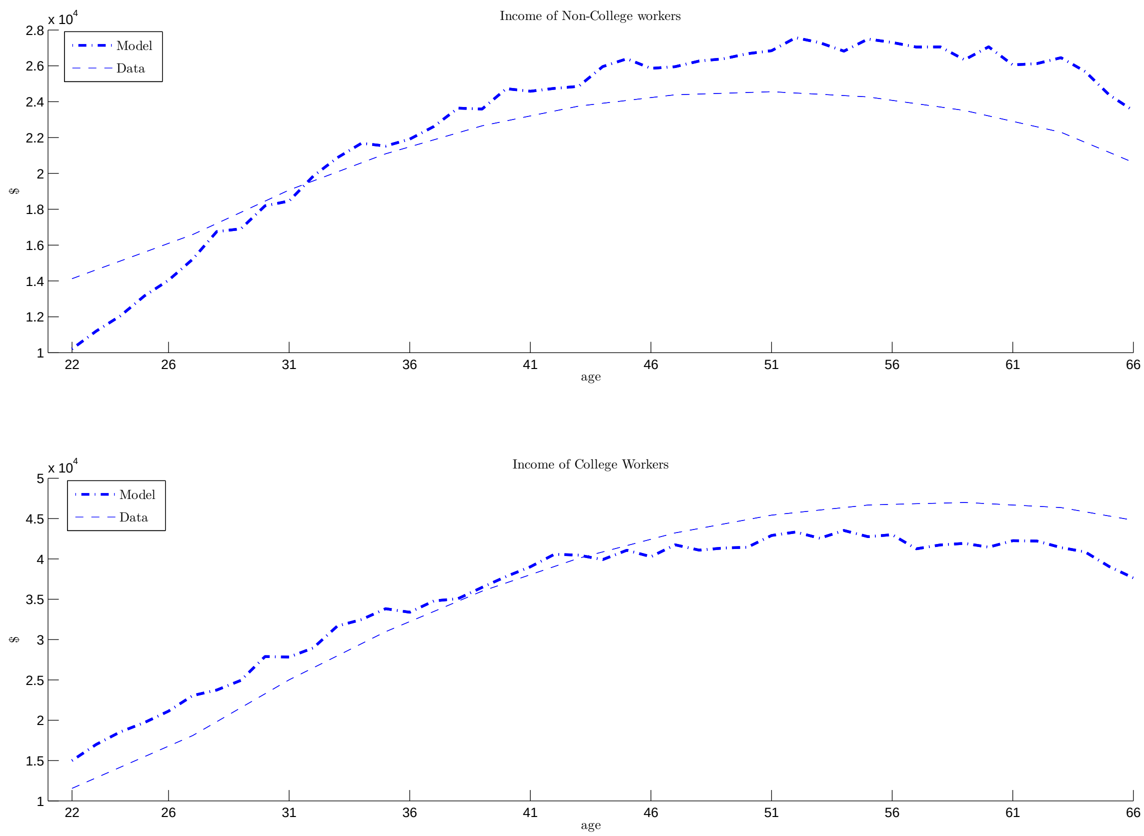

Figure 3: Income of Workers

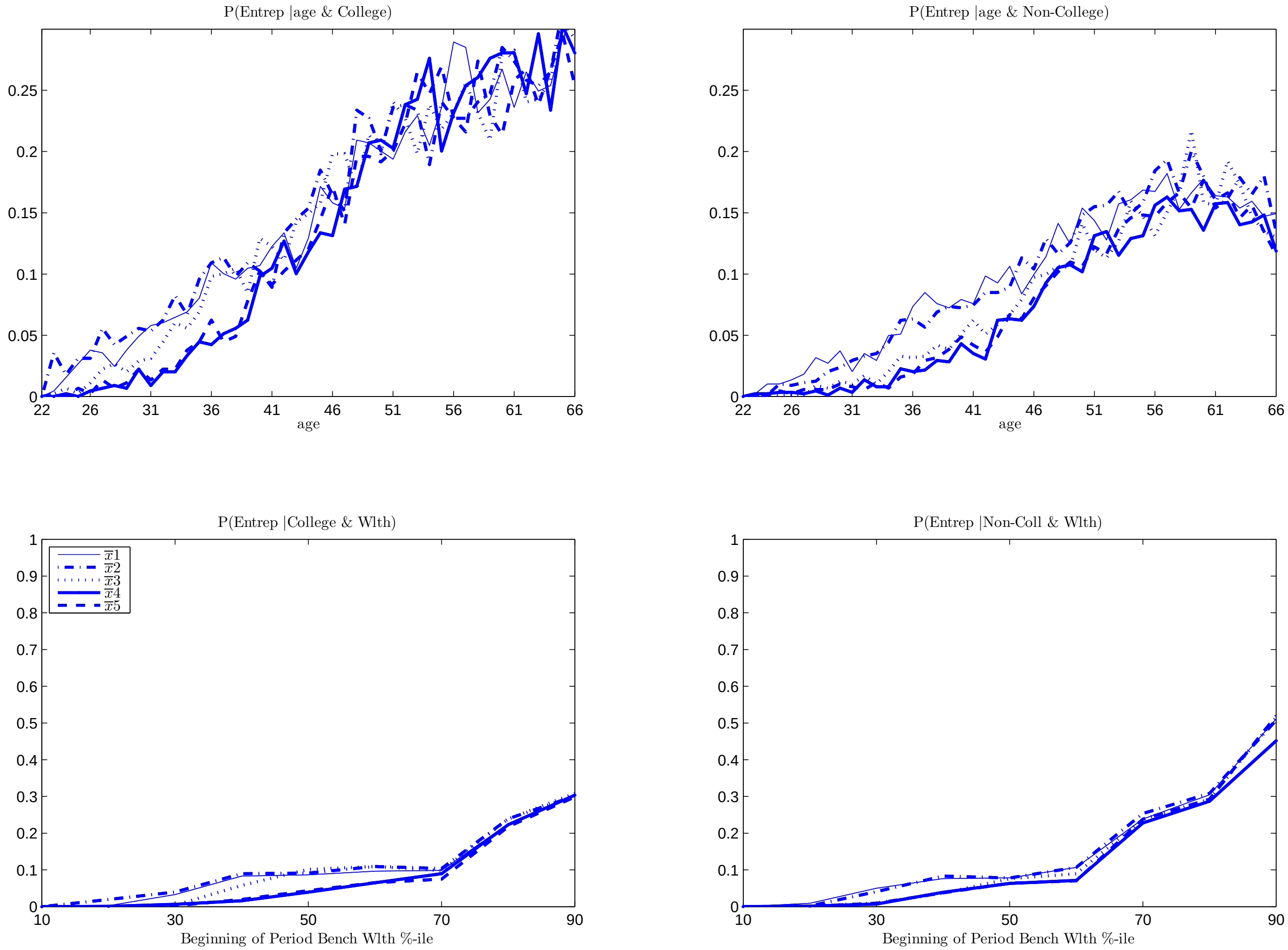

Figure 4: Self–Employment Rate by Age and Wealth

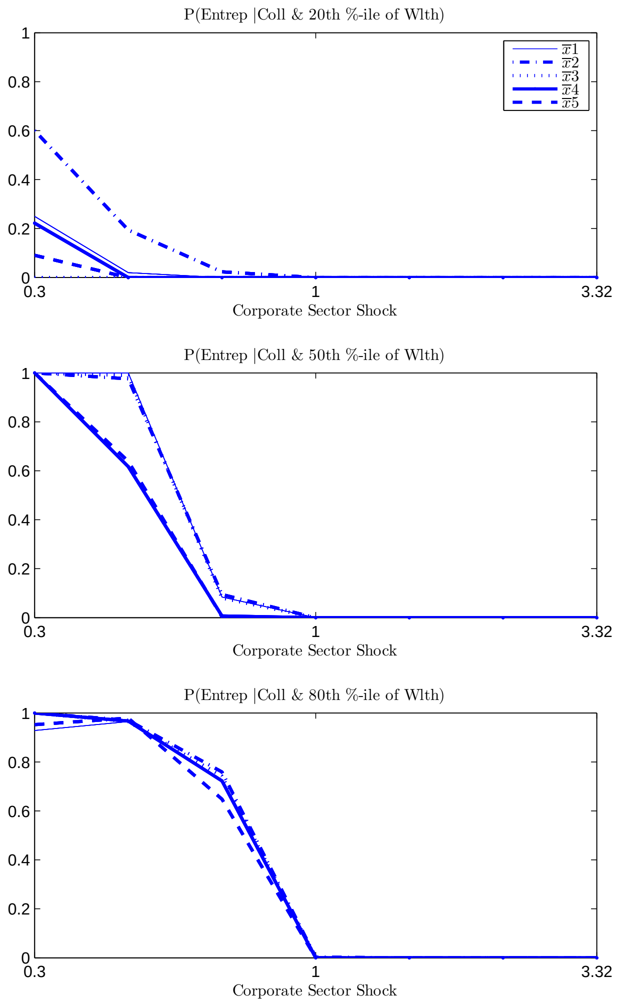

Figure 5: Corporate Productivity and Occupational Choice

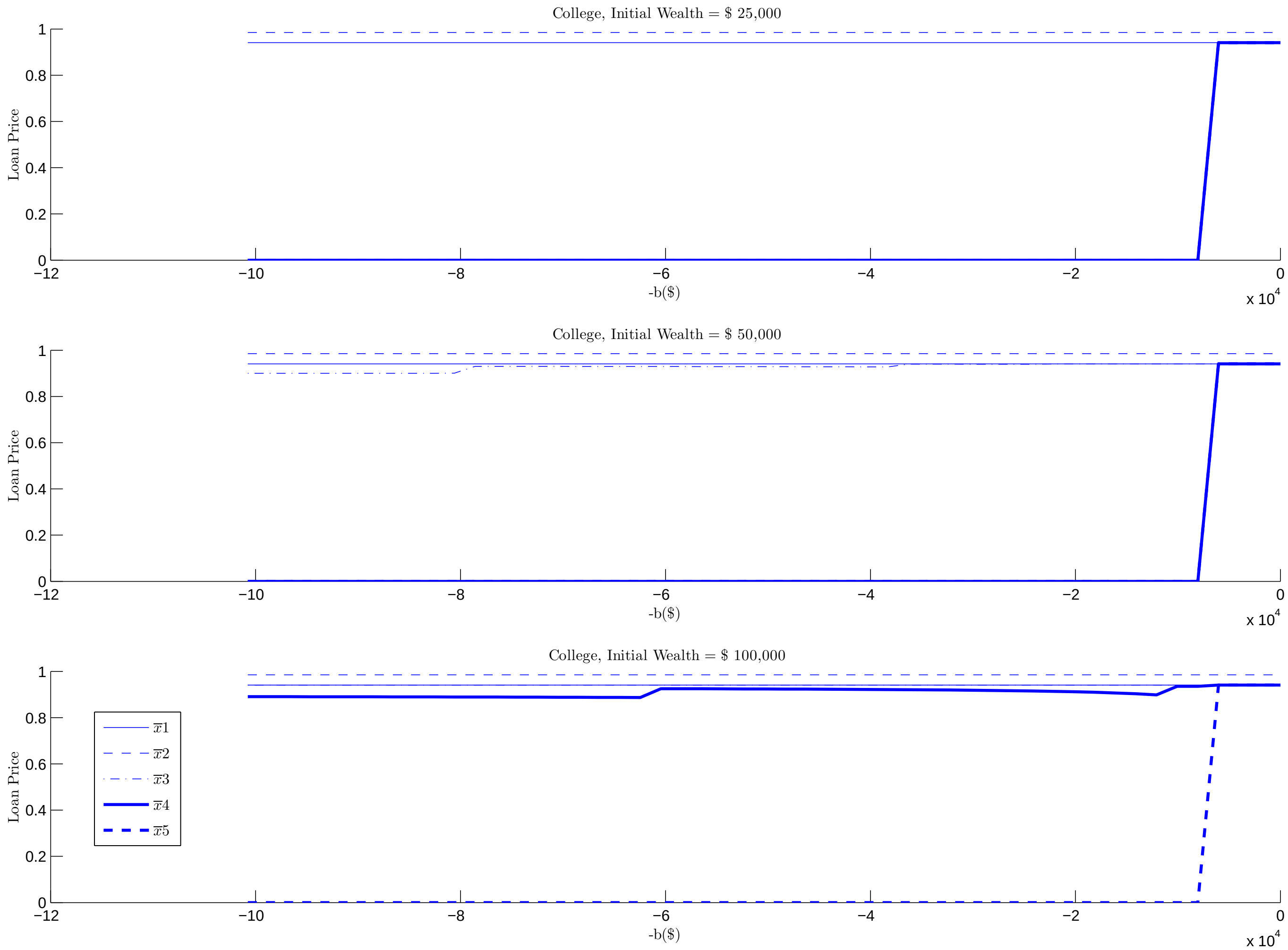

Figure 6: Loan Pricing