

Unsecured Credit and Self-Employment^{*}

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Abstract

Limited personal liability for debts has long been justified as a tool to promote entrepreneurial risk taking. Nonetheless, such limits erode repayment incentives, and so may increase unsecured borrowing costs. Given the tradeoff between credit costs and insurance against failure, how does liability policy matter for entrepreneurship? The main message of this paper is that limits to liability for debt repayment, especially those created by US law through the personal bankruptcy code, create a serious barrier to entrepreneurial activity, and decrease long-run welfare. Our results emerge from a model of entrepreneurial activity in which the limited liability for debts is treated in a historically relevant context: namely, that of risk-averse households investing heavily in risky, poorly diversifiable projects. Moreover, we find that limited liability significantly alters the timing of self-employment by shifting borrowing away from younger and poorer households, to older, richer ones. In sum, strict limits to liability impede credit markets, and do so in a way that is quite regressive.

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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, who channel 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.

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 risk to lenders that imply 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 1700's 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 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–

¹Throughout 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.

taking (see also *The Economist*, 2006).

In addition to credit conditions, those contemplating self-employment must evaluate the latter 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), Fairlie and Krashinsky (2006) each shows 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. 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 to be an entrepreneur.

Since limits to liability may actually create the credit constraints that other major policies aim to mitigate, it is crucial 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. Our analysis places heavy emphasis on the household-level decisions generating the preceding aggregates. In particular, we uncover the role played by liability policy in influencing credit constraints, risk-taking, and self-employment choices over the entire life-cycle.

Our central result is that limited liability, especially in the manner delivered by current US bankruptcy policy, represents an important barrier to entrepreneurial activity and lowers long-run welfare. Ironically therefore, limited liability works in opposition to its original mandate to promote self-employment. In particular, despite the fact that the “ex-post” insurance to borrowers rises with the level of wealth that they may shelter from creditors in default, we find as follows. Generous limits to liability imply that (a) entrepreneurship rates fall, (b) entrepreneurs pay more for credit (c) entrepreneurs borrow less (d) delay self-employment until they are wealthier (e) low-skilled households bear the costs of reduced access to credit very disproportionately, (f) mean project size shrinks, (g) the standard deviation of asset holdings decreases, (h) entrepreneurial tenure grows shorter, (i) the probability of staying as an entrepreneur conditional on filing for bankruptcy in the previous period increases, and (j) steady-state welfare declines monotonically.

Our study is novel along several dimensions. First, ours is a quantitative evaluation of limited liability for self-employment, which is a principal reason for the former’s very

existence. Second, relative to existing research (e.g. Athreya, 2006; Chatterjee et al., 2002), our work is novel in using quantitative theory to understand the role that limits to liability play in risk-taking, as opposed to risk-sharing of an exogenous income stream. The former is the problem germane to the self-employed, who may enter and exit at will, while the latter best describes paid workers. Third, 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.

Our equilibrium approach allows us to overcome several crucial measurement problems that hinder purely empirical studies of self-employment. First, and most centrally, we model the real option faced by households regarding their occupational choices. Data on self-employment is by definition censored, capturing only those for whom such a choice was preferred to an unobserved alternative. A key payoff to our approach is that we will shed light on who does *not* choose self-employment, and how credit policy, wealth, and the outside alternative all jointly determine entrepreneurial activity. For example, we find that the young and poor are relatively far more sensitive to the opportunities in the paid work sector than their high wealth counterparts. In particular, we find that as paid work becomes more remunerative, households require systematically greater initial wealth before they become willing to try entrepreneurship. This finding is a key payoff to our equilibrium approach, as we are able to “observe” behavior at wage rates for even those choosing not to work in the corporate sector.

Second, our equilibrium setting overcomes 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.”. Thus, the econometrician at best observes only the final borrowing decision and the associated terms. Our framework, by contrast, allows us to evaluate the extent to which borrowing is limited by lenders fears of repayment as opposed to borrowers’ fears of being unable to make good on additional debts.

Lastly, our model also helps us overcome several additional problems facing empirical analyses of interstate variation in liability policy. First, differences across states in the legal structures, tax laws, and banking regulations applicable to small-businesses are exceedingly complex (see Cullen and Gordon, 2002). The combination of these elements is what ultimately determines to what extent risk-averse entrepreneurs have access the insurance embedded in “limited liability”. Second, households move, leaving open the question of precisely which set of laws apply. Elul and Subramanian (2002) find evidence for deliberate “forum shopping” among debtors contemplating default. Lastly,

liability policy itself appears to be endogenous (see e.g. Skeel, 2001; Posner et al., 2001), having emerged in response to particular features of either (i) a geographically unique production technology, or (ii) inter-state political economy concerns. Our set-up is transparent, because it allows for a variety of counterfactual experiments which clearly isolate the common threads linking limited liability and credit costs to occupational choice, risk sharing, and household well-being.²

Our paper is closest to Terajima (2004), Polkovnichenko (2003) and ongoing work of Meh and Terajima (2005) in that we emphasize the role played by human capital combined with entry and exit options. Terajima (2004) studies a general model of occupational choice but abstracts from credit frictions. Meh and Terajima (2005) focus on bankruptcy, but also study home ownership decisions, in a setting where occupations are chosen before any uncertainty is resolved. By contrast, it is crucial for us to allow for the incentives that produce entry to self-employment as a consequence of poor outside opportunities, and therefore study a set up where corporate sector productivity is learned prior to occupational choice within a period. Relative to Polkovnichenko (2003), our set-up integrates a richer model of age-related productivity, with a detailed account of the credit market and its lending terms. Our paper also incorporates the insight that when private information, as opposed to limited commitment, precludes state-contingent contracts, deliberate ceilings on liability can improve welfare. With respect to work connecting limited commitment to credit rationing, Cagetti and De Nardi (2006), Albuquerque and Hopenhayn (2004), Quintin (2003), and Krasa et al. (2004), all assume either complete markets or the absence of risk-sharing motives. Therefore, these studies rule out any positive role for limits to liability, and instead deal purely with the question of how much credit is restricted by limited liability. The remainder of the paper is organized as follows. Sections 2 and 4 present and parameterize the model; Sections 3 and 5 present welfare measurement and results. Section 6 concludes.

2 Model

2.1 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

²Nonetheless, as mentioned above, our findings are consistent with the most careful empirical work on bankruptcy exemptions to date, that of Gropp et al. (1997).

discrete and is indexed by $j = 1, 2, \dots, J$. An agent's consumption in age- j is denoted by c_j . The within-in-the period utility function is given by $u(\cdot)$ where $u'(\cdot) > 0$, $u''(\cdot) < 0$. 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 $\phi(\cdot)$. We assume that $\phi'(\cdot) > 0$, and $\phi''(\cdot) < 0$. Therefore, given the discount factor $\beta \in (0, 1)$, households maximize:

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

An important aspect of our model is that we use the simplest framework possible to isolate the effect of limited liability on access to credit and on the self-selection of households into entrepreneurial activity. Our goal, is not, for example, to uncover the role of entrepreneurship for inequality, as many previous studies have done. We therefore 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 e.g. Quadrini (2000). We also abstract from complex details of the tax system.³ 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 **(ii)** self-selection into self-employment.

2.2 Timing, Occupational Choice, and Default

In each period, households choose between being a worker or an entrepreneur for that period.⁴ At the beginning of each period, a household learns its 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 distribution of outcomes.

With respect to the corporate sector, labor productivity takes on values in a finite set, i.e. $\epsilon^j \in \{\epsilon_1^j, \epsilon_2^j, \dots, \epsilon_N^j\}$, for $j = 1, \dots, J$, with each period's shock drawn according to the (possibly) age-dependent probability distribution $g_j(\epsilon)$. We denote the mean level of corporate sector productivity at age- j , for human capital h , by $\mu^{Corp}(j, h)$.⁵ 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 $\epsilon_n \mu^{Corp}(j, h)$.

³See Meh (2005) for the effects of taxes on entrepreneurship.

⁴The timing is similar to Meh (2005), and also rules out “mixing” salaried work and self-employment for self-insurance purposes.

⁵The uncertainty of wage income eliminates the possibility of a non-degenerate wealth distribution, and makes the dynamics of agent's wealth interesting.

By contrast, agents who choose entrepreneurship operate a stochastic technology denoted by $\mathcal{F}(\theta, k, h)$ whereby gross output depends on the privately observed shock, θ , the human capital level, h_i , and a production technology $\mathcal{F}(\cdot)$. The productivity shock θ takes values in $\{\theta_1, \dots, \theta_N\}$, and its density is given by $\pi(\theta)$.⁶ The variable k denotes the size of the capital stock used in the entrepreneurial project. It can take values on the set $k = [0, \bar{k}]$ where $\bar{k}$ 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. This enables us to retain focus on the role played by the unsecured credit market.

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, and permanent, productivity differences between agents during working life, and is exogenously determined in the first period of the agent's life.⁷ 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.⁸

⁶The effect of h on entrepreneurial income is qualitatively identical to that of ϵ on labor income.

⁷Human capital may be interpreted as an agent's education level, e.g. college graduate vs. non-college graduate.

⁸For 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 likely to raise capital from venture capitalists, and therefore, can potentially avoid limited commitment problems in debt contracts.

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, 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 $k \equiv q(h, a, b)b + a$.⁹ Once project size is determined, the entrepreneur observes the shock $\theta(h)$, 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 $\theta(h)$, 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. We denote exemptions by $\bar{x}$, whereby given output $\mathcal{F}(\theta, k, h)$, post-default wealth is simply $\min(\mathcal{F}(h, \theta, k), \bar{x})$. Thus, higher exemptions allow for more wealth to be sheltered while debts are repudiated. Throughout this paper, limited liability will be completely defined by the parameter $\bar{x}$. A defaulting household must also pay transactions costs, denoted by τ_B .¹⁰ 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, $\bar{x}$. Following the decision to repay debt, the household divides 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 a fraction, η , of any entrepreneurial output (including undepreciated capital) above the exemption level. Denote the sum of current output and undepreciated capital by $\mathcal{F}(h, \theta, k)$, i.e. $\mathcal{F}(h, \theta, k) \equiv \rho(h)f(\theta, k) + (1 - \delta)k$. The function $\rho(\cdot)$ allows the relative productivity of entrepreneurs of different human capital levels to differ from the corporate sector skill premium. When productivity and bankruptcy decisions have been made, households choose consumption and savings. The period then ends. The timing is summarized in Table 1.

⁹Representing borrowing by nonnegative scalar b is convenient as it makes the capital stock an nondecreasing function of borrowing for all $q \geq 0$.

¹⁰These 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.

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 $\phi(\cdot)$. 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 an probability distribution $\varsigma(h'|h)$, that depends explicitly on parental human capital.

2.2.1 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. Given $(1 + r^f)$ and τ , the zero-profit discount rate on a risk-free loan, which we denote by q_l^f , is given as follows. Therefore, the cost of collecting one unit of funds by the lender is given by $(1 + r^f + \tau)$. The zero-profit discount rate is then simply the reciprocal. That is,

$$q_l^f = \frac{1}{(1 + r^f + \tau)}. \quad (2)$$

For any given internal wealth and debt level, there is a (possibly empty) set of realizations for productivity, denoted $D(h, a, b, q)$, such that the agent prefers default to repayment whenever $\theta \in D(h, a, b, q)$. Notice that in general, the pricing scheme q and default decision D influence each other. In particular, pricing matters for default as it governs how a given debt issuance in the current period translates into repayment requirements in the next period. Conversely, default risk matters for pricing as lenders must cover costs in competitive equilibrium.

The set $D(h, a, b, q)$ 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

$$\sigma(h, a, b, q) \equiv \Pr(\theta \in D(h, a, b, q)) = \sum_{\theta \in D(h, a, b, q)} \pi(\theta). \quad (3)$$

The amount

$$\Omega = \sum_{\theta \in D(h, a, b, q)} \pi(\theta) \left(\eta[\mathcal{F}(h, \theta, k) - \bar{x}] \right) \quad (4)$$

is the expected amount of output paid to the banks by these agents, conditional on $\mathcal{F}(h, \theta, k) - \bar{x} > 0$. For a loan of type (a, b) to a households of a particular human capital level, h , the lender uses a discounting scheme, $q(h, a, b, D)$, in order to break even.¹¹ Therefore, given that h can take two values, the economy has two different loan discount rates in equilibrium for a particular loan type (a, b) .

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

$$(1 + r^f + \tau)qb = b(1 - \sigma(h, a, b, q)) + \Omega \quad (5)$$

where the left-hand side of (5) is the total costs of making loans of size qb , and the right-hand side is the sum of revenues from non-defaulting borrowers and recovered revenues from defaulting borrowers. Expressed in terms of a premium over risk-free borrowing, we have the following fixed-point condition:

$$q(h, a, b, D) = q_l^f \left[(1 - \sigma(h, a, b, q)) + \frac{\Omega}{b} \right] \quad (6)$$

Given a loan size $bq(\cdot)$, 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, $\max(0, \eta[\mathcal{F}(h, \theta, k) - \bar{x}])$. 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 of these two types of credit can be only made by the corresponding loan prices, i.e. $q(\cdot)$. Notice also that if the default set $D(h, a, b, q)$ is empty, the loan is risk-free, and therefore $\sigma(h, a, b, D) = 0$. This leads (6) 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 that fact that were borrowing to reach certain levels, default likelihoods would justify the rates.

Notice that limits to liability, by reducing the amount that the agent can credibly commit promise to surrender in default, limit the usefulness a given amount of internal wealth. In turn, ex-ante, agents react to generous exemption levels by accumulating wealth, all else equal, precisely to access secured debt.

¹¹This pricing scheme is standard. For applications see Chatterjee et al. (2002), Livshits et al. (2003), Athreya (2006), and Athreya and Simpson (2006).

Our restriction that households use their internal wealth in the project, and only then turn to outside finance, is equivalent to a set up where households obtain a line of credit for any wealth in the form of ownership of durables, and liquidate their financial wealth before using unsecured credit. Given the observed price differential between secured and unsecured debt, this is a benign abstraction.

2.3 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:

$$V(S) = \max\{V^e(S), V^w(S)\}, \quad (7)$$

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 (7). 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 $j = 1, 2, \dots, J-1$. 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 define the value function for a worker.

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

$$V^e(S) = \max_{b_j \geq 0} \{E_\theta W(S, b_j, \theta)\}. \quad (8)$$

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 whose beginning-of-period state is S , who has chosen to borrow b_j units, and who then receives productivity θ . for an age- j household. By definition, $W(S, b_j, \theta)$ solves

$$W(S, b_j, \theta) \equiv \max \left\{ W^B(S, b_j, \theta), W^{NB}(S, b_j, \theta) \right\}. \quad (9)$$

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 $\mathcal{F}(h, \theta, k_j)$, which depends on the realization of θ , and the current-period transactions cost for default, τ_B . Letting $V(S')$ denote the expected continuation value in state S' , we then have:

$$W^B(S, b_j, \theta) = \max_{a_{j+1}} \{u(c_j) + \beta EV(S')\} \quad (10)$$

$$\text{such that } c_j + q^f a_{j+1} \leq \min[\bar{x}, \mathcal{F}(h, \theta, k_j)] - \tau_B \quad (11)$$

$$k_j = a_j + q(h, a_j, b_j, D)b_j \quad (12)$$

$$k_j > 0, \quad c_j \geq 0, \quad a_{j+1} \geq 0, \quad b_j \geq 0, \quad \forall j = 1, J-1. \quad (13)$$

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

$$W^{NB}(S, b_j, \theta) = \max_{a_{j+1}} \{u(c_j) + \beta EV(S')\} \quad (14)$$

$$\text{such that } c_j + q^f a_{j+1} \leq \mathcal{F}(h, \theta, k_j) - b_j \quad (15)$$

$$k_j = a + q(h, a_j, b_j, D)b_j \quad (16)$$

$$k_j > 0, \quad c_j \geq 0, \quad a_{j+1} \geq 0, \quad b_j \geq 0, \quad \forall j = 1, J-1. \quad (17)$$

Entrepreneurs of age J solve the same discrete optimization problems in (7) – (9) as entrepreneurs of other ages, with only the modification that the discounted expected continuation value is given by $\phi(\cdot)$. Therefore, the modified objective function of an age- J entrepreneur choosing bankruptcy is:

$$W^B(S, b_J, \theta) = \max_{a_{J+1}} \{u(c_J) + \phi(a_{J+1})\}. \quad (18)$$

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

$$W^{NB}(S, b, \theta) = \max_{a_{J+1}} \{u(c_J) + \phi(a_{J+1})\}. \quad (19)$$

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:

$$V^w(S) = \max_{a_{j+1}} \{u(c_j) + \beta EV(S')\} \quad (20)$$

$$\text{such that } c_j + q^f a_{j+1} = \epsilon_n \mu^{Corp}(j, h) + a_j \quad (21)$$

$$c_j \geq 0 \quad , \quad a_{j+1} \geq 0, \quad \forall j = 1, J-1. \quad (22)$$

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

$$V^w(S) = \max_{a_{J+1}} \{u(c_J) + \phi(a_{J+1})\} \quad (23)$$

subject to the same constraints as all other workers. With the preceding value functions in hand, the original comparison to determine occupational choice, in (7), can be made for all ages $j = 1, 2, \dots, J$.

2.4 Equilibrium

Given the individual state space S , we can define $X = [0, \infty) \times \{1, 2, \dots, J\} \times \{\epsilon_1^j, \epsilon_2^j, \dots, \epsilon_N^j\} \times \{h_1, h_2, \dots\} \times \{\theta_1, \dots, \theta_N\}$. Let $(X, \mathbb{B}(X), \omega)$ be a probability space where $\mathbb{B}(X)$ is the Borel σ -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 (7)–(23), 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:

$$\omega^*(\mathcal{C}) = \int_X P(x, \mathcal{C}) d\omega^* \quad (24)$$

More precisely, the equilibrium is defined as follows:

Definition 1 *Given an exemption level, $\bar{x}$, a risk-free discount rate on deposits, q^f , a transaction cost on intermediation, τ , and human capital transitions across generations, $\varsigma(\cdot)$, 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 (7) – (23), 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 (7) – (23).*
2. *Lenders make zero expected profits on each loan, i.e. the discount rate q is given by (6).*
3. *Distributions are stationary and consistent with individual optimal choices as described in (24).*

3 Welfare Measurement

The welfare criterion used here is the expectation of discounted utility taken with respect to the invariant distribution associated with the equilibrium stochastic process for the state, and is standard in the literature (see e.g. İmrohoroglu, 1989, 1992). It is therefore equivalent to the expected utility of facing a lottery over the initial state (S , as denoted earlier) where one's initial state is chosen according to the stationary distribution prevailing in a given economy. It is denoted by Φ and is given below.

$$\Phi = \int_S V(S) d\omega(S), \quad (25)$$

where $V(\cdot)$ is the agent's value function defined in (7), and ω is the equilibrium joint distribution of agents over the state space.

In order to compare welfare under different exemption levels, we use a measure of equivalent variation that asks the following question. What *constant* proportional increment/decrement, Ψ , to *benchmark* consumption, will make agents indifferent between being assigned an initial state according to the stationary distribution prevailing in the benchmark, and being assigned a state according to the distribution obtaining under a proposed policy experiment? Thus, $\Psi > 0$ implies that a proposed policy improves welfare, and $\Psi < 0$, the reverse. Let Φ^b denote welfare/ex-ante expected utility in the benchmark economy, and let Φ^p denote welfare under a proposed policy.

4 Parameters

We parameterize the model in order to generate outcomes consistent with observations under current US liability policy. Specifically, our parameter choices are aimed at approximating (i) the joint distribution of human capital and occupational choice in the US economy, (ii) entrepreneurial borrowing and default, (iii) the relative incomes and wealth holdings of skilled and unskilled workers and entrepreneurs, and (iv) their

volatilities. The full list of parameters is given in Table 2, and the fit of the benchmark model is given in Table 3.

4.1 Preferences

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

$$u(c) = \begin{cases} \frac{c^{1-\xi}}{1-\xi} & \text{if } \xi > 1 \\ \log(c) & \text{if } \xi = 1 \end{cases} \quad (26)$$

where ξ denotes the coefficient of relative risk aversion. Given CRRA preferences and the definition of welfare above, it is easily shown that:

$$\Psi = \left(\frac{\Phi^p}{\Phi^b} \right)^{\frac{1}{1-\xi}} - 1 \quad (27)$$

We set ξ equal to 2, as is standard. The model period corresponds one calendar year, and our benchmark calibration sets $\beta = 0.94$. We parameterize the retirement-wealth valuation function such that it has the identical form, i.e.

$$\phi(a_{J+1}) = \frac{a_{J+1}^{1-\xi}}{1-\xi} \quad \text{with } \xi = 2, \quad (28)$$

which given wealth accumulation patterns during working life, allows us to approximate median wealth among 65-year old household while eliminating an additional free parameter.

4.2 Labor Productivity

Our model partitions the population by human capital levels and occupational choices, and we therefore closely follow Terajima (2004) 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. We therefore 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 Heathcote et al. (2005), 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 $\mathcal{F}(h, \theta, k) \equiv \rho(h)\theta k^\gamma + (1 - \delta)k$, where mean entrepreneurial productivity is governed by the age-invariant function $\rho(h)$. We assume for simplicity that $\rho(\cdot)$ alters the entrepreneurial productivity of human capital by a scalar factor across entrepreneurs of different human capital levels. Specifically, we normalize $\rho(h_{hs}) = 1$, and then set $\rho(h_c) = \kappa h_{hs}$. Our benchmark calibration yields $\kappa = 1.35$, implying that the mean productivity of a college-educated entrepreneur is 1.35 times that of a non-college-educated entrepreneur.

The production parameter γ is common to all entrepreneurial ventures, and is set to 0.708, as measured in Terajima (2004), and is also close to the value in Cagetti and De Nardi (2006). A common returns-to-scale parameter allows us to limit additional (free) parameters so that we can focus on the tension between the insurance provision and credit limits created by the ability to shelter wealth while repudiating debts.

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 $\mu_{\theta_c} = -1.66$, and standard deviation $\sigma_{\theta_c} = 0.69$. For high-school educated households, given $\kappa = 1.35$, we have $\mu_{\theta_{hs}} = -1.97$, and $\sigma_{\theta_{hs}} = 0.92$. This parameterization allows us to closely match the observed distribution of “types” in the economy, i.e., the respective sizes of

the populations of low- and high human capital workers and entrepreneurs, as well as a variety of relative quantities such as income, wealth, and earnings variability. The relative riskiness of corporate and entrepreneurial productivity is also consistent with estimates of Hamilton (2000).¹²

4.4 Credit Markets and Bankruptcy

With respect to the costs of borrowing and the returns to saving, we have two parameters. These are, respectively, the risk-free rate earned on savings $1/q^f$, and the transactions costs associated with financial intermediation τ . We set the risk-free rate following Mehra and Prescott (1985) at 1%, implying $q^f = 0.99$. For the transactions cost of unsecured credit intermediation, we use the estimates of Evans and Schmalensee (1999), and Davis, Kubler, and Willen (2005) and set $\tau = 0.06$.

With respect to costs of bankruptcy, to capture various fees and court costs associated with the actual bankruptcy filing procedure, we assign $\tau_B = 0.005$, which corresponds to roughly \$4000, given the total of legal fees, court costs, and other miscellaneous expenses as documented, e.g. in Caher and Caher (2003). Measuring the liquidation value, η , is more difficult for several reasons. These include the lack of accurate data in personal bankruptcy repossessions, the asset-specificity of the capital stock of many small enterprises, the non-trivial portion of business expenses for services (e.g. working capital), and in part because of the explicit protection offered to “tools-of-trade” described above. We set our benchmark liquidation value at $\eta = 0.8$, to reflect a standard upper bound on loan-to-value ratios maintained in secured lending. Moreover, our choice for η is also disciplined by the fact that our benchmark model matches debt in bankruptcy.

We set the target default rate at 2.5%, to accord with the work of Rodríguez et al. (2002), Sullivan et al. (1989), and Sullivan et al. (2000). This work indicates that bankruptcy occurs often in households who fail in business projects.^{13,14} Recently, Lawless and Warren (2005) report that at 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

¹²For computation, we discretize the distribution of shocks, following the procedure of Tauchen (1986), into seven values.

¹³The bankruptcy option available to non-entrepreneurs may change the results to the extent that the equilibrium interest rates respond to their default rates and volumes of credit discharged. The explicit modeling of the bankruptcy option for these households, however, may also make the analysis opaque.

¹⁴Our results are robust to the choice of this target, as we experimented with targets as low as 1%.

form the model corresponds most closely represents) has, over the past decade, averaged approximately 1.25% of U.S. households annually (see American Bankruptcy Institute: www.abiworld.org). 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.¹⁵ Our target, in turn, follows Sullivan et al. (2000), who suggest that the self-employed file roughly twice as frequently as the general population, giving us a target of 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 follow Sullivan et al. (2000), who argue that properly measured, the self-employed discharge roughly twice as much debt as the mean amount discharged by working households. This implies a target of approximately \$80,000, which our benchmark model slightly overpredicts. Overall, however, as seen in Table 3, our benchmark calibration is able to capture very well not only the occupational distribution of US households, but also their relative earnings, as well as the observed age-profile of self-employment.

4.5 Exemptions

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 *financial* wealth that a household may retain ex-post bankruptcy. In choosing experiments that apply the model in the most appropriate manner, we therefore proceed as follows. The class of assets that households retain in our model are much narrower than the broad classes of assets held by most US households. Notably, we prevent the use of human wealth within the period, as a household learns of a project’s outcome, and can supply labor to the alternative sector only in

¹⁵For 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 are 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.

the next period if the outcome is poor. Given the one-year model period, such a restriction is presumably stronger than that faced by households, who retain their own human wealth, and often, that of a spouse. Moreover, wage-garnishing is legally highly restricted in most states, making human capital very difficult to seize ex-post. Lastly, in addition to human wealth, households also retain access to a menu of *non-transferable* assets that entitle them to publicly and privately provided transfers from programs such as Medicaid, TANF, as well as transfers from extended family etc.

To parsimoniously capture households' access to this broader classes of *de-facto* exempt assets, we bound from below the set of exemptions under study at \$40,000. Values below this level represent far more stringent restrictions than we believe to be (i) relevant, and (ii) implementable via bankruptcy policy alone. In particular, default without going through legal procedures is also possible, and is something we do not model here, which again puts a clear limit on the reduction of exemptions possible via policy.¹⁶

The exemption level in the bankruptcy law corresponds to two types of protection of assets of borrowers. In particular, the statutes specify separate limits on the value of residence and “tools-of-trade” under which the defaulting borrower can shelter his wealth.¹⁷ We include both limits when we compute the magnitude of total exemptions available to the borrowers. The exemption level in the bankruptcy code of Chapter 7 varies significantly across states in the U.S. We select a benchmark level of approximately \$95,000 (Rodríguez et al., 2002). This benchmark captures the sum of median annual household income and 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 \$40,000 to \$160,000.¹⁸

¹⁶However, for completeness, we have computed equilibria under exemptions of very nearly zero. The implementation of such a policy is likely to require severe garnishment, and supervision (to overcome the moral hazard induced by garnishment). However, we do find that in this case, allocations are such that steady-state welfare is substantially higher than for more “local” perturbations to exemptions. This suggests that ultimately, the inalienability of human capital is a key barrier to welfare gains.

¹⁷Besides these exemptions, most states also exempt personal items, such as furniture, clothing, and kitchen utensils.

¹⁸While 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.

5 Results

5.1 Bankruptcy Policy and Aggregate Outcomes

We begin by summarizing the main statistics of interest under each of five exemption levels in Table 4. The highlights of this table are as follows. First, and most importantly, the aggregate entrepreneurship rate decreases monotonically with exemptions. Under the lowest exemptions we consider, the rates of self-employment are 36% and 30% for College and non-College educated households, respectively. By contrast, under the highest exemption level we consider, the rates for these two groups shrink substantially, to 10% and 12%, respectively. In terms of the unconditional self-employment rate, between the two extreme of policies we consider, varies from 33% to 11%. Lastly, the impact of exemptions on entrepreneurship rates, and outcomes more generally, are greatest when relatively low, and “flatten” significantly at higher exemption levels.

The decline in entrepreneurship is also accompanied by a sharp decline in the use of credit. This association, when accompanied by the model’s predictions for the entire equilibrium credit pricing function, appears causal. Namely, exemptions appear to lower entrepreneurship precisely by increasing the cost of credit. In terms of distributional consequences, exemptions generate relatively mild effects on the behavior of the college-educated, but much more severely affect the choices available to non-college educated. This differential impact is seen most clearly in the use of credit. While under the lowest exemptions, fully 78% of non-college entrepreneurs borrow, under the highest exemption, only 22% do so. For college-educated households, borrowing rates fall less sharply, and remain much higher at all exemption levels, going from 91% to 68% as exemptions increase from their lower bound to their upper limit.

The reduced use of credit with increased exemptions also surfaces in the increased age at which households (at the mean) are self-employed. For college-educated households, the lowest exemptions lower the mean age of the self-employed by nearly four years. For the non-college-educated, the differences are not important.

Predictably perhaps, bankruptcy rates rise monotonically as we move from the lowest exemptions to the benchmark, and increase especially sharply between the fourth and fifth exemptions (representing exemptions of \$125,000 and \$160,000, respectively). Lastly, in terms of steady-state welfare, the results are unambiguous: high exemptions harm households, substantially. The welfare gains, for example, from going from the benchmark to the lower bound we consider, is on the order of a permanent gain in consumption of five-percent.

The predictions of our model are consistent along several dimensions with co-movements

between exemptions, credit markets, and self-employment uncovered by recent empirical work. Moreover, our framework is sufficiently general to account for these co-movements simultaneously. Most recently, Berkowitz and White (2004) predicts that higher personal bankruptcy exemptions increase interest rates and cause “credit-rationing.” Furthermore, Gropp et al. (1997) find that exemptions, rather than encouraging default and risk-taking, may simply ration low-income households out of credit markets, while redistributing credit to wealth-rich households. Lastly Fan and White (2003) find, as we do, that very generous exemptions can lower self-employment rates.¹⁹ Perhaps most importantly, our equilibrium approach suggests that from a steady-state welfare perspective, the tradeoff induced by bankruptcy, whereby ex-post insurance is forced upon all un-collateralized debtors, is simply not worth it.

We now attempt to account for the observed changes in aggregate outcomes by investigating how exemptions affect decision-making among various subsets of the population partitioned by age, wealth, educational attainment, and corporate-sector productivity.

5.2 Generous Bankruptcy Policy Means Fewer Entrepreneurs

What is the role of bankruptcy policy in influencing who chooses entrepreneurship? In Figure 1, we plot the probability of becoming an entrepreneur as a function of age, education, and wealth, under a variety of exemption levels. Beginning with the top left panel of Figure 1, it is immediately clear that increased exemptions unambiguously lower the rate of entrepreneurship across different age groups and human capital level. For all ages, the likelihood of being self-employed falls with exemptions. Moreover, we find that the biggest *increases* in entrepreneurship with age occur when exemptions are lowest. Notably, under the lowest level of exemptions, we see that for college-educated households, entrepreneurship rates among those aged thirty and above rise from 20% to nearly 60% near retirement, which while emerging from a counterfactual experiment, is a substantially larger increase than occurs in the benchmark case. This holds true for non-college-educated household as well. By contrast, under exemptions at, or above, the benchmark US level, those below thirty years of age rarely become entrepreneurs, while their older, and richer counterparts, do so at much higher rates.

¹⁹However, Fan and White (2003) argue that exemptions, on net, can encourage entrepreneurship. However, this inference appears in part driven by the presence of some state-level fixed effects. In particular, Fan and White (2003) find that households were more likely to start a business in a state with a very high exemptions-even if they were renters. The latter are by definition ineligible for the largest single exemption-that on home equity. Similarly, Georgellis and Wall (2004) argue for important state-level fixed effects in clouding direct inference from correlations between exemptions and entrepreneurship.

The fact that exemptions influence the path of wealth accumulation is seen in Figure 2, with the highest exemptions yielding the least accumulation, and the lowest exemptions yielding the most. This pattern is indicative of the high returns that self-employment offers, allowing for greater wealth accumulation. In fact, given that the ability to borrow cheaply is greatest under low exemptions, young households borrow heavily to finance projects which make them, on average, much richer than they otherwise would have been. In Table 5, we see that the average project size of an entrepreneur, which includes both internal funds and external credit, increases monotonically for both college and non-college graduates as exemptions are lowered. In Table 6, we observe that this increase in average project size translates into larger average project income of entrepreneurs. Thus, increased access to cheaper credit, as seen in Table 6, through lower exemptions leads to larger average income for entrepreneurs net of loan repayments. In addition, agents receiving low wage shocks are willing to attempt risky entrepreneurship more frequently with cheaper credit. Hence, in equilibrium, the average income of a worker also increases since those agents with low wage shocks “escape” their bad luck. This increase in average income in the economy allows agents to accumulate more wealth on average. Notice that higher credit costs could potentially induce agents to save more and accumulate more wealth in order to be able to run entrepreneurial projects, as emphasized in Quadrini (2000). In our setup, however, the access to inexpensive credit encourages agents to run risky and productive projects which in turn increase their average income. The effect of the increase in average income is more dominant than the direct negative effect of lower credit costs on savings.

5.3 Generous Bankruptcy Implies Expensive Credit

Perhaps the most important payoff to our equilibrium approach is that we are able to uncover the credit pricing function implied by bankruptcy policy and competition among lenders. This function reveals the menu of loan prices, for *all* debt levels that a household may choose to evaluate. Critically, this set includes all prices not directly observed on the equilibrium path. To demonstrate the importance of such information for understanding the impact of bankruptcy exemption policy, consider first either Figure 3, or Table 5. These sources are informative precisely because they show us that the prices actually paid *in equilibrium* change very little with bankruptcy policy. Nevertheless, we see from the aggregate self-employment rate that exemptions do matter for outcomes. If so, where do we see this? A first place to see this is in the distribution of equilibrium debts, as shown in Figure 4. However, the reduced loan size is itself an outcome, not a parameter for the individual household. These facts, taken together,

indicate that loan pricing must have changed, and in Figure 5, we show that this is exactly the case.

Figure 5 collects loan discount functions across exemption levels, by displaying the rate at which debt issuances by the self-employed are discounted relative to their face value (interest rates are the reciprocal of this measure). This figure reveals the importance of default law in systematically altering the cost of credit for all households. At a qualitative level, it is clear that the higher the exemption level, the higher the price of credit, especially for households who hold relatively low wealth. More specifically, even under fairly strict (i.e. low) exemptions, households lack access to much credit. In fact, even households with a net worth of \$50,000 may not borrow substantially at the risk-free rate, except at the lowest exemption level. When exemptions are increased, matters worsen, and the household becomes essentially unable to issue debt, and must wait until middle age to become viably self-employed. In sum, our results strongly suggest that exemptions can be meaningfully accused of create credit ‘constraints’-especially for the poorest, youngest, and least-skilled of US households.

5.4 Generous Bankruptcy Lowers Unsecured Credit Use

It may seem obvious that more expensive credit will lead to less of it being used. However, it is important to remember that exemptions were created originally *precisely* to encourage borrowing and risk-taking. In particular, the main reason that credit terms worsen with exemptions is that larger exemptions endow loans with ever greater state-contingency, providing increasing amounts of insurance to the borrower. That is, the “insurance” value to the borrower of issuing debt rises with exemptions. Therefore, as noted by Gropp et al. (1997), *demand* for loans could rise by enough to generate even greater borrowing in equilibrium under high exemptions than under low ones. Our central concern in this paper is, as a quantitative matter, the following. Will improvements in the risk-sharing properties of debt, ultimately encourage, or stifle, credit use? To measure the strength of the ex-ante disincentives seen in the price of credit against the incentives created by the insurance provisions, we turn to Figure 4, where we report the distribution of borrowing levels among those choosing self-employment. Turning first to the top two panels in the figure, what is clear is that the upper bound on borrowing (i.e. maximal debt) falls monotonically as exemptions rise. Moreover, the middle panel shows that the distribution of debts among the high-school educated is sharply lower under all exemptions than for the college-educated. This is a consequence of both the fact that such households face more difficulty in committing to repay, but also because they operate projects that yield lower average returns. The relative size of

borrowing across the two educational groups under benchmark exemptions is isolated in the bottom panel of the Figure 4.

5.4.1 Exemptions Create Credit Constraints

A key stylized feature of the data on entrepreneurship is that wealth and entrepreneurship are correlated. The latter finding is also the fundamental basis for the widely held view that many would-be entrepreneurs are credit constrained, often quite severely. The previous two subsections established respectively that, increasing exemptions makes credit more expensive, and by so much that households either defer, or ultimately do not pursue, self-employment. These two observations, when combined with our finding, seen earlier in Figure 1, that entrepreneurship rates increase systematically with both wealth and age, allow for an interpretation of the data as being driven by “credit-constraints”. We turn next to a key distributional issue: do exemptions affect the poor (the unskilled) by more or less than the rich (the skilled)?

5.5 Generous Bankruptcy is Regressive

5.5.1 High Exemptions Shift Unsecured Credit Away from the Young and the Poor

From a distributional standpoint, one of the most noticeable differences is in the way exemptions differentially affect high and low human capital households.²⁰ A first sign of the “regressivity” of a generous bankruptcy law can be seen in the way that the probability of using credit markets changes as exemptions are increased. In Figure 6, we show four panels each giving the probability that an entrepreneur of the given “type” (e.g. by wealth, age and education level) will use the credit market. We see in top row that when for college-households exemptions are at their lowest, there is a simple, monotonically declining likelihood of borrowing as households age, while for non-college households, the lowest exemptions yield the highest likelihood of borrowing, at any age.

As the amount of borrowing falls, so does the likelihood of borrowing at all. Among entrepreneurs, the proportion borrowing falls dramatically with exemptions for those who are not college educated. For example, nearly 80% of College and non-College educated self-employed use credit when they are in their 30’s under the lowest exemptions. However, for those with high-school education only, this proportion falls sharply

²⁰Recall that the human capital level of a borrower is perfectly observable to the lender, the loan pricing function takes this information into account.

to less than 10% when exemptions are increased to the US benchmark. By contrast, this proportion remains very high, at over 90%, for college-educated households (see Figure 6). In large part, the likelihood of borrowing is driven simply by the price of borrowing, seen earlier in Figure 5.

Given the shift in credit pricing, how does bankruptcy policy alter the importance of initial wealth for self-employment? In the bottom row of Figure 6 we see that for households of both human capital levels, higher exemptions systematically lower the probability of credit use, for all levels of wealth. Conversely, for a given exemption, higher wealth systematically increases the probability of credit use.

Returning to the top row of Figure 6, when comparing the two panels, we see that under the lowest exemptions, there is a difference in the likelihood of borrowing, but is mostly among the youngest. By age thirty, this gap is much narrowed. Perhaps more striking is the effect of exemptions on the relative importance of debt in financing a project. In Figure 7, we see first that debt/equity ratios are far lower, by a factor of nearly three, for non-college households. Second, we find that the ratio of debt to equity is highest for entrepreneurs of both human capital levels under the lowest exemptions.²¹ However, when exemptions are increased, non-college households begin to drop out of the unsecured credit market altogether, while college-educated households continue to borrow, though at lower rates. Our findings here are consistent with empirical work of Gropp et al. (1997), who, using data from the 1983 Survey of Consumer Finances, argue that generous bankruptcy exemptions reduce the amount of credit to low-wealth households and increase its availability to high wealth households.

5.5.2 High Exemptions Effectively Limit Occupational Choice

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. In Figure 8, we report the fraction of households who choose entrepreneurship as a function of their current corporate sector productivity (with median productivity normalized to unity), for each of three levels of wealth. Each row of Figure 8 contains the results for a given level of exemption, for both human capital levels. It is immediately clear that household occupational choices depend importantly on all three factors.

First, holding corporate sector productivity fixed, we see in Figure 8 that as wealth

²¹This differential use of credit markets is still driven by the fact that our minimal exemption level remains quite far from zero. We found that in the (highly counterfactual) case when exemptions were literally eliminated, that debt equity ratios became essentially equalized across entrepreneurs of different human capital levels.

increases, the fraction of households in that state who choose entrepreneurship rise systematically. For example, in the economy with the lowest exemption level (i.e. the Top Panel of Figure 8, college-educated households in the 80th wealth percentile who receive the lowest corporate-sector productivity choose nearly unanimously to become entrepreneurs. However, those at the median do so at a much lower rate of 40%, while those in the 20th percentile simply do not switch. This pattern is also similar for high-school educated households, though the rich among them (e.g. those in the 80th percentile of the unconditional wealth distribution) choose self-employment at higher rates. Conversely, for the highest realization of current corporate sector productivity, wealth and exemptions no longer matter, as no one chooses self-employment.

In terms of how exemptions alter the role played by corporate sector productivity, as we move down each column of Figure 6, we see that for the poorest households (top row), the measure of households who enter self-employment falls for a given corporate productivity level as exemptions are increased. This is a direct consequence of the increased cost of credit that was reported above. That is, credit costs rise with exemptions, and in turn, effectively force even those with low productivity to remain in paid work, rather than allowing them to escape to self-employment. Perhaps most notable is that among the unskilled poor, as captured in the decisions of high-school educated households in the 20th percentile of wealth (right column of Figure 6), entry to self-employment simply stops altogether under high exemptions. The only deviation from the monotonic influence of exemptions occurs among low productivity households of median wealth or greater, where the lowest exemption level we consider does not generate the highest self-employment rate. It is for this set of households where the insurance benefits of exemptions appear to trump the increased cost of credit.

However, while the insurance value of being able to switch occupations can be driven even by relatively rare realizations of poor corporate-sector productivity, does the entry/exit option matter for aggregates? Specifically, to gain a sense of the extent to which the outside option matters for the aggregate self employment rate, notice that while households at either extreme of the corporate-sector productivity distribution are heavily influenced to enter or exit self-employment, the *size* of this highly responsive group is small. This is simply because the shocks are log-normal, implying that strongest incentives are created by values for the shock that are two and three standard deviations away from the mean, which few households receive. In Figure 10, we display the conditional probability distribution of a current corporate-sector productivity for those who have chosen entrepreneurship. We see that the median entrepreneur is only slightly less productive in the corporate sector than the median worker. Moreover, we see that exemptions are quite unimportant for this distribution. Given the role played

by wealth in the decision to enter self-employment, we conclude that while exemptions matter for the extensive margin, they do so by influencing wealth accumulation, as seen earlier in Figure 2.

In the ‘neighborhood’ of the modal shock (unity), we observe that it is wealth which matters most. In particular, exemptions and outside productivity exert significantly less influence here. In Figure 11, we show that corporate sector productivity matters for occupational choice, but nonetheless, does so when wealth “allows” households to try it. In the top panel, we see that under all but the strictest exemptions, even among those receiving the lowest corporate productivity, only those with wealth near the median or above consider self-employment. As seen by comparing the middle and top panels of Figure 11, for exemptions closer to US practice, corporate sector productivity matters for occupational choice in the sense the threshold level of wealth (in percentiles defined by the benchmark wealth distribution) falls with corporate productivity.

Lastly, we turn to Figure 12. In this figure we present more ‘unconditional’ information, where we report the measure of self-employed households for any particular level of corporate productivity, across all five exemption levels. We see that exemptions matter at least as much as productivity, in the sense that reasonable variations in exemptions can generate changes in behavior equivalent to very large changes in productivity.

5.6 Project Size, Entrepreneurial Tenure, and “Fresh Start”

A striking finding is that by sharply increasing the cost, and lowering the use, of unsecured credit, equilibrium project size falls. In Table 5, we see that the average project size falls monotonically as exemption levels grow. When combined with our finding that the extensive margin responds nontrivially, we see that by altering the threshold for internal wealth levels that make self-employment desirable to households, the effect of exemptions will be seen not only in when (i.e. in the age-distribution of entrepreneurs) but also on what scale households run self-employment projects. Of course, the shift in financing-away from the credit market and towards self-finance, was precisely what we saw earlier in Figure 7, and was notably, most severe for the unskilled self-employed. Therefore, exemptions appear fundamentally to be regressive.

In Table 4, we report the median and standard deviation of the spell distribution of self-employment for both college and non-college agents. We find that the median is equal to one year in the benchmark case, and invariant to changes in exemption levels for both types of education groups.²² However, the standard deviation is monotonically declining with higher exemption levels for both education levels, implying that long

²²This is also consistent with the findings in Rissman (2006).

spells of self-employment become more uncommon as exemptions rise. As discussed earlier, high credit costs, due to higher exemption levels, render self-employment less desirable. Thus, a larger fraction of entrepreneurs receiving low productivity shocks are unwilling to borrow and continue self-employment in subsequent periods.

Chapter 7 bankruptcy, to which our model most closely corresponds, is known as “fresh start” bankruptcy. That is, the exchange of non-exempt wealth in exchange for the elimination of unsecured debt was intended to allow filers to begin life anew. Do generous exemption levels imply a “fresh start” for entrepreneurs? To answer this question, we calculate the probability of entrepreneurship in the current period conditional on filing for bankruptcy in the previous period. We report these conditional probabilities under different exemption levels in Table 4. There is a monotonic increase in the likelihood of “re-entry” into entrepreneurship after bankruptcy when exemptions rise. In particular, for the non-college agents, the increase is very steep, and appears to suggest that the bankruptcy option provides agents with a “fresh start.” However, this result is driven by the fact that under high exemptions it is typically the relatively wealthy who attempt self-employment. Therefore, in a bankruptcy, such households can retain large amounts of wealth. On the other hand, under low exemption levels, agents can retain limited amounts of wealth in bankruptcy, and are, therefore, less likely to re-enter entrepreneurship. Notice that the wealthy choose self-employment at higher rates for *all* exemption levels. In sum, generous exemptions restrict the set of agents (i.e. wealthy agents) such that the conditional probability of entrepreneurship following bankruptcy becomes misleading regarding the extent of the fresh start provided by bankruptcy. Thus, it is misleading to view the data as supporting the fresh start argument in favor of bankruptcy.

5.7 Welfare

In this section, we provide some welfare implications while always holding wealth fixed. The numbers must therefore be interpreted as the consumption equivalent that is required to keep households with a given wealth level indifferent between the benchmark economy, and one in which a new policy has been in place for long enough for loan pricing to have adjusted fully.

In Table 4, steady state welfare comparisons reveal that generous exemptions hurt both college and non-college agents in the economy. Notice also that the standard deviation of assets declines monotonically with higher exemption levels, as reported in Table 4. The decreased volatility in asset holdings is an outcome of the more frequent use of the bankruptcy option, as well as the larger amount of wealth retained during

bankruptcy when exemptions are generous. Lower volatility in asset holdings implies a *decline* in welfare for an individual whose value function, given in (7), is rendered convex in assets because of the entry and exit option (see also Hopenhayn and Vereshchagina, 2005).

The top panel of Figure 13 shows that while the welfare gains to most households are minimal, the gains accruing to wealthier ones are not. As seen earlier, the sum of implicit and explicit exemptions available to US households makes entrepreneurship a relatively wealthy person’s occupation. In turn, the impact of exemption policy is naturally strongest here. As with nearly every other result we have presented, exemptions below the benchmark increase welfare, while levels above decrease it. Moreover, our welfare calculations, as stated above, do not conflate welfare arising purely from the higher equilibrium levels of average wealth that emerge from lower exemptions.

In the middle panel, the “hump” in welfare gains occurs at lower wealth percentiles—simply because this is the range of wealth levels at which non-college entrepreneurs become marginal with respect to entrepreneurship, and therefore are sensitive to exemptions.

5.8 Limited Commitment Revisited

Before concluding, we return to the issue of the selection of exemption levels. Our goal was to better understand the implications of an official policy intended originally to encourage entrepreneurs by limiting their liability in bad states of the world. We argued that even under extremely stringent exemption policies, US households generally still retain a variety of inalienable assets, most obviously human capital and claims to public transfers.²³ Within the range of bankruptcy policies that met this criterion, we found substantial distortions to the timing and financing of entrepreneurial ventures. However, it is of interest to report that much larger gains appear available. Specifically, we find that *de facto* elimination of the ability to retain wealth after default profoundly altered outcomes.

We first demonstrate how important limits to liability actually are for outcomes, by imposing a (very) counterfactually stringent limit to wealth holdings in default of approximately \$5000. In top panels of Figure 14, we see that credit constraints disappear, in the sense that these households have access to huge amounts of credit at the risk-free rate, even when they have low net worth. In the case studied here, we see that

²³Recall that agents cannot mix salaried work with self-employment which puts a limit on self-insurance. One can argue that a defaulting entrepreneur does not suffer as much as in the model as long as the wage income of his/her spouse is uncorrelated with the entrepreneur’s productivity.

households with just \$50,000 of net worth may borrow up to \$450,000 of debt at the risk-free rate for even households).

However, what is perhaps even more interesting is that the wealth-entrepreneurship correlation *still remains intact*, as seen in bottom panels of Figure 14. The implication of this is clear: positive wealth-self-employment correlations are not unambiguous evidence of credit constraints. Our equilibrium approach allowed us to open the ‘black-box’ of loan pricing to show that access to credit can vary substantially for a given relationship between wealth and self-employment.

Steady-state welfare gains of an order of magnitude greater are also realized by such a move. We therefore read our results as telling us two things. First, that it is very important to choose bankruptcy policy carefully. Second, it is perhaps ultimately most crucial to consider the impact that the inalienability of certain assets classes has on the ability of the poor and unskilled to access credit and choose self-employment. We leave this for future work.

6 Conclusion

The main message of this paper is that the limits to liability, especially those created by US law through the personal bankruptcy code, create a serious barrier to entrepreneurial activity, and decrease long-run welfare. Ironically therefore, limited liability works in opposition to its original mandate to promote self-employment. In particular, despite the fact that the “ex-post” insurance to borrowers rises with the level of wealth that they may shelter from creditors in default, we find as follows. Generous limits to liability imply that (a) entrepreneurship rates fall, (b) entrepreneurs pay more for credit (c) entrepreneurs borrow less (d) delay self-employment until they are wealthier (e) low-skilled households bear the costs of reduced access to credit very disproportionately, (f) mean project size shrinks, (g) the standard deviation of asset holdings decreases, (h) entrepreneurial tenure grows shorter, (i) the probability of staying as an entrepreneur conditional on filing for bankruptcy in the previous period increases, and (j) steady-state welfare declines monotonically. Our results are striking as they obtain in a setting where limited commitment to repay debts is placed in the presence of impediments to insurance whereby limited liability could potentially emerge as quite useful.

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Table 1: Sequence of Events in a Given Period

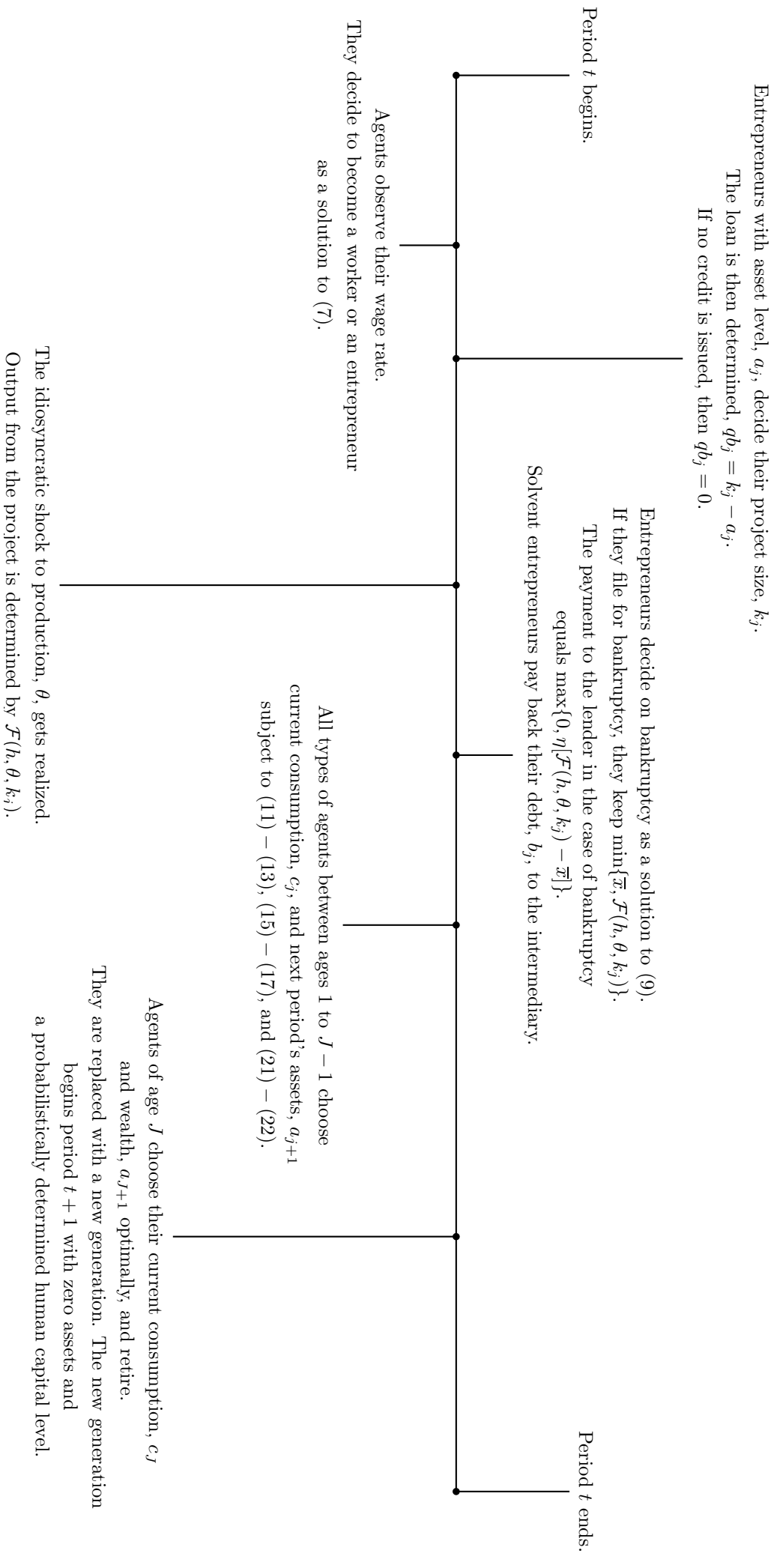


Table 2: **Parameters**

Preferences		
β	0.94	calibrated
$u(c) = \frac{c^{1-\xi}}{1-\xi}$	$\xi = 2$	an estimate from micro-studies.
$\phi(a_{J+1}) = \frac{a_{J+1}^{1-\xi}}{1-\xi}$	$\xi = 2$	calibrated.
Labor Productivity		
$h = \{h_c, h_{hs}\}$	$\varsigma(h' = h_c h = h_c) = 0.61,$ $\varsigma(h' = h_c h = h_{hs}) = 0.21$	calibrated.
$\mu^{Corp}(j, h)$	calibrated	Heathcote et al.(2005).
Entrepreneurial Production		
$\mathcal{F}(\cdot) \equiv \rho(h)\theta k^\gamma + (1 - \delta)k$	$\rho(h_{hs}) = 1, \rho(h_c) = 1.35,$ $\gamma = 0.708.$	calibrated, see Terajima(2004).
$\log \theta \sim N(\mu_{\theta_i}, \sigma_{\Theta_i})$	$\mu_{\Theta_c} = -1.66, \sigma_{\Theta_c} = 0.69.$	calibrated.
$i = c, \text{ and } i = hs$	$\mu_{\Theta_{hs}} = -1.97, \sigma_{\Theta_{hs}} = 0.92.$	
Credit Markets		
q^f	0.99	Mehra and Prescott (1985).
τ	0.06	Evans and Schmalensee (2005)
τ_B	0.005 in model units, approx. \$4,000.	calibrated.
η	0.8	calibrated.
Exemptions		
$\overline{x} = \{\overline{x}1, \overline{x}2, \overline{x}3, \overline{x}4, \overline{x}5\}$ in dollars	$\overline{x} = \{40,000, 65,000, 95,000, 120,000, 160,000.\}$ $\overline{x}_{bench} = \overline{x}3 = \$95,000.$	calibrated.

Table 3: **The Match of Benchmark Model to Data**

Calibration			
		Benchmark	Data
Bankruptcy Rate		0.025	0.025
P(Entrepreneur College)		0.20	0.20
P(Entrepreneur Non-College)		0.14	0.14
P(Entrep & College)		0.07	0.07
P(Entrep & Non-College)		0.09	0.09
P (Entrepreneur)		0.16	0.16
Mean Debt Discharged in Bankruptcy		−\$105,000.00	−\$80,000.00
Median Entrepreneurial Spell Length (Years)		1	1
Relative Earnings	Non-Coll Worker :College Entrep	0.20	0.26
	Non-Coll Entrep :College Entrep	0.39	0.38
	College Worker :College Entrep	0.41	0.55
	College Worker :Non-College Worker	2.09	2.09
	College Entrep :Non-Coll Entrep	2.56	2.63
	Non-Coll Entrep :Non-Coll Worker	1.97	1.44
Relative Wealth	Non-Coll Worker :College Entrep	0.08	0.06
	Non-Coll Entrep :College Entrep	0.49	0.27
	College Worker :College Entrep	0.17	0.22
	College Worker :Non-College Worker	2.19	3.67
	College Entrep :Non-Coll Entrep	2.05	3.70
	Non-Coll Entrep :Non-Coll Worker	6.43	4.50
Relative Coefficient of Variation of Earnings	Non-Coll Worker :College Entrep	0.50	0.36
	Non-Coll Entrep :College Entrep	1.60	1.36
	College Worker :College Entrep	0.51	0.91
	College Worker :Non-College Worker	1.02	2.54
	College Entrep :Non-Coll Entrep	0.62	0.73
	Non-Coll Entrep :Non-Coll Worker	3.21	3.81

Table 4: Summary Statistics

Exemption Levels						
	Human Capital	$\bar{x}1$	$\bar{x}2$	$\bar{x}3$	$\bar{x}4$	$\bar{x}5$
P(Entrep)	College	.3630	.2820	.2009	.1454	.0978
	Non-College	.3074	.2059	.1402	.1220	.1156
	Unconditional	.3261	.2315	.1607	.1299	.1096
P(Entrep & Agent Type)	College	.1223	.0950	.0677	.0490	.0330
	Non-College	.2039	.1365	.0930	.0809	.0767
P(Entrep Bankr. in period $t - 1$)	College	0	0	0	.0182	.0364
	Non-College	0	.1417	.2267	.3469	.5672
P(Borrow)	College	.3324	.2573	.1782	.1239	.0667
	Non-College	.2386	.1408	.0602	.0302	.0256
P(Borrow Entrep)	College	.9157	.9126	.8869	.8526	.6813
	Non-College	.7764	.6841	.4292	.2474	.2216
Average Age of Entrepreneurs	College	27.73	29.42	31.39	31.87	31.87
	Non-College	30.39	31.06	30.86	30.80	30.80
Bankruptcy Rate	College	.0066	.0104	.0131	.0220	.0408
	Non-College	.0068	.0227	.0313	.0408	.2993
	Unconditional	.0067	.0185	.0252	.0345	.2123
Welfare Gains relative to Bench	College	6.85%	3.38%	0%	-2.32%	-4.34%
	Non-College	9.09%	3.31%	0%	-0.83%	-1.12%
	Unconditional	8.65%	3.32%	0%	-1.12%	-1.75%
Std. Dev. of Assets in \$	College	212,260	189,205	162,275	137,405	113,862
	Non-College	148,675	114,696	79,085	71,338	61,227
Coefficient of Variation of Assets	College	1.416	1.498	1.571	1.616	1.693
	Non-College	1.751	1.938	1.915	1.927	1.759
Entrepreneurial Spell Distribution	College	M*	1	1	1	1
		SD**	3.459	3.116	3.089	2.715
	Non-College	M*	1	1	1	1
		SD**	4.450	2.593	2.385	2.219

* M = the median of the distribution.

** SD = the standard deviation of the distribution.

Table 5: **Percentage Changes in Mean Values [1]**

		Exemption Levels				
	Human Capital	$\bar{x}1$	$\bar{x}2$	$\bar{x}3$	$\bar{x}4$	$\bar{x}5$
Consumption	College	9.76%	4.46%	\$63,528	−3.53%	−7.02%
	Non-College	22.53%	8.80%	\$29,903	−2.08%	−3.09%
Consumption Worker	College	2.14%	0.27%	\$55,444	0.38%	0.36%
	Non-College	−0.45%	−0.67%	\$27,028	0.08%	0.31%
Consumption Entrepreneur	College	−3.10%	−1.99%	\$95,673	−1.34%	−5.22%
	Non-College	23.25%	14.60%	\$47,529	−4.61%	−8.98%
Borrowing Entrepreneur	College	16.86%	11.07%	−\$279,246	−11.91%	−37.77%
	Non-College	155.63%	96.42%	−\$38,668	−49.95%	−61.81%
Project Size	College	6.46%	4.03%	\$569,654	−6.33%	−21.25%
	Non-College	64.86%	39.81%	\$186,559	−15.21%	−26.13%
Debt Discharged in Bankruptcy	College	14.00%	−0.40%	−\$228,501	−11.45%	−36.51%
	Non-College	90.44%	90.21%	−\$42,158	83.02%	107.32%
Returns to Projects**	College	26.36%	26.55%	27.66%	28.97%	32.15%
	Non-College	31.66%	34.60%	39.80%	41.83%	42.38%
Y/ Assets in Beginning of Pd**	College	148.06%	141.81%	136.83%	134.35%	131.73%
	Non-College	141.74%	136.85%	135.49%	135.24%	135.04%

** not presented in deviations from benchmark.

Table 6: **Percentage Changes in Mean Values [2]**

		Exemption Levels				
	Human Capital	$\bar{x}1$	$\bar{x}2$	$\bar{x}3$	$\bar{x}4$	$\bar{x}5$
Income	College	12.84%	6.03%	\$64,670	−4.05%	−7.56%
	Non-College	12.23%	6.48%	\$29,405	−3.70%	−7.02%
Labor Income of Workers	College	5.41%	2.32%	\$59,015	−1.15%	−1.84%
	Non-College	0.98%	0.26%	\$28,267	−0.24%	0.29%
Project Income of Entrepreneurs	College	5.39%	2.82%	\$142,600	−5.89%	−19.99%
	Non-College	51.03%	29.42%	\$55,661	−11.96%	−28.31%
Assets of Workers	College	23.20%	10.38%	\$51,383	−7.45%	−15.64%
	Non-College	15.22%	7.46%	\$23,454	−3.53%	−4.03%
Assets of Entrepreneurs	College	−2.54%	−2.03%	\$309,807	−1.44%	−7.11%
	Non-College	42.87%	26.27%	\$150,760	−6.67%	−14.42%
Unconditonal Assets	College	\$149,938	\$126,300	\$103,311	\$85,027	\$67,265
	Non-College	\$84,923	\$59,205	\$41,305	\$37,028	\$34,818
Gross Average Interest Rates on Loans	College	1.0724	1.0742	1.0766	1.0818	1.0994
	Non-College	1.0749	1.0817	1.1005	1.1086	1.4725
Ratio of Labor Productivity of Workers to Labor Productivity of Entreps	College	1.2696	1.2551	1.2472	1.2485	1.2871
	Non-College	1.1381	1.2350	1.3068	1.3295	1.3422

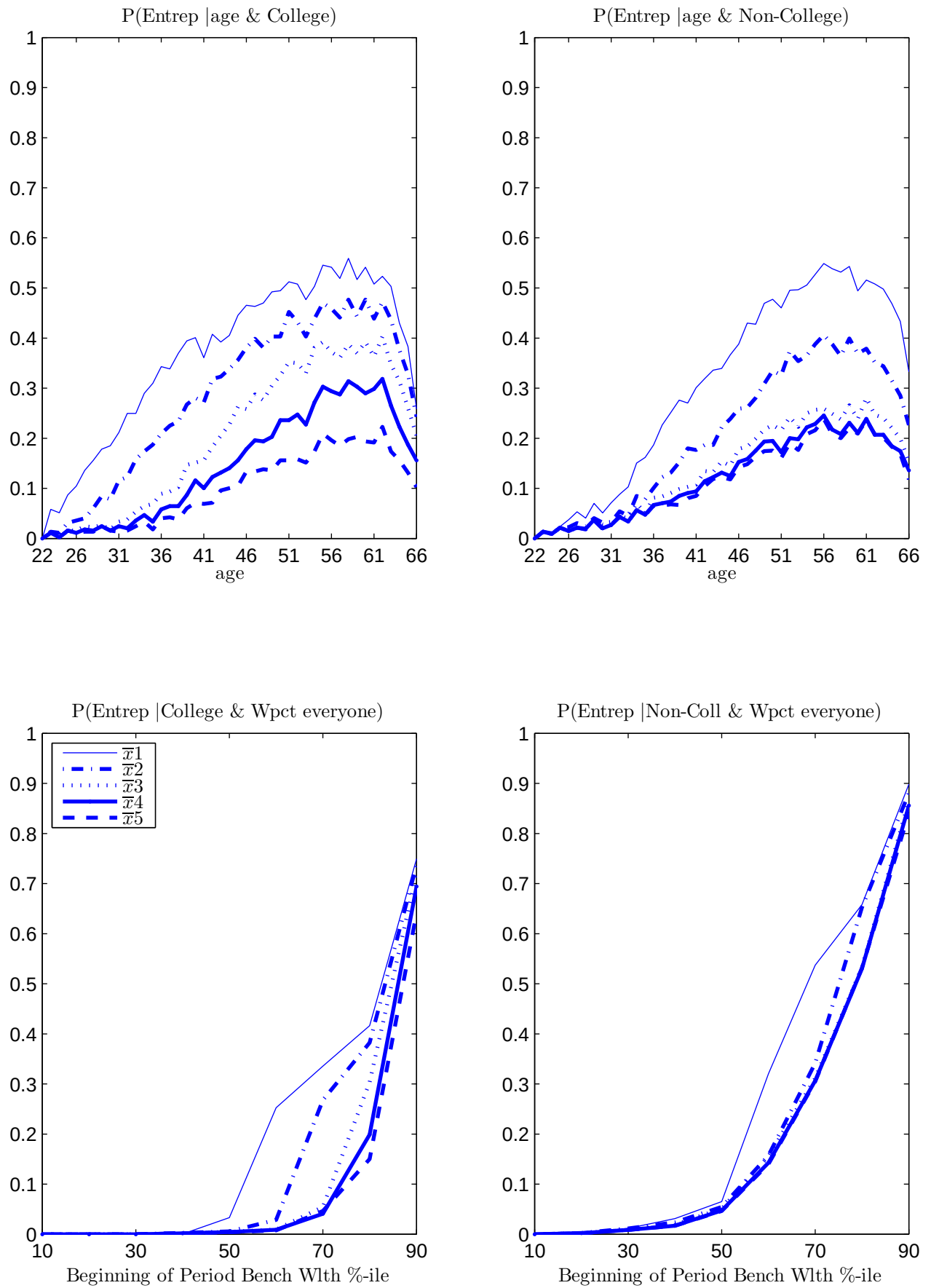


Figure 1: Probability of Entrepreneurship given Age, Education, and Wealth

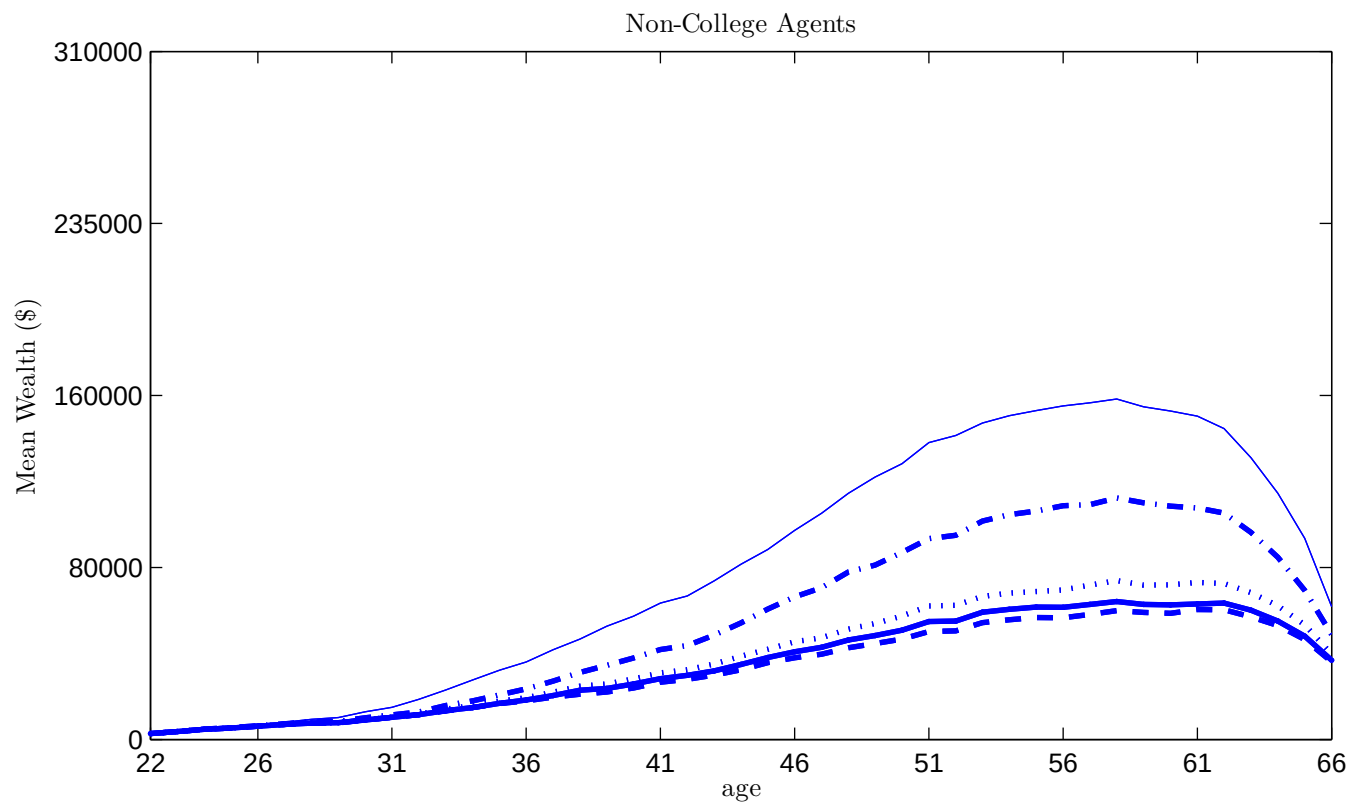
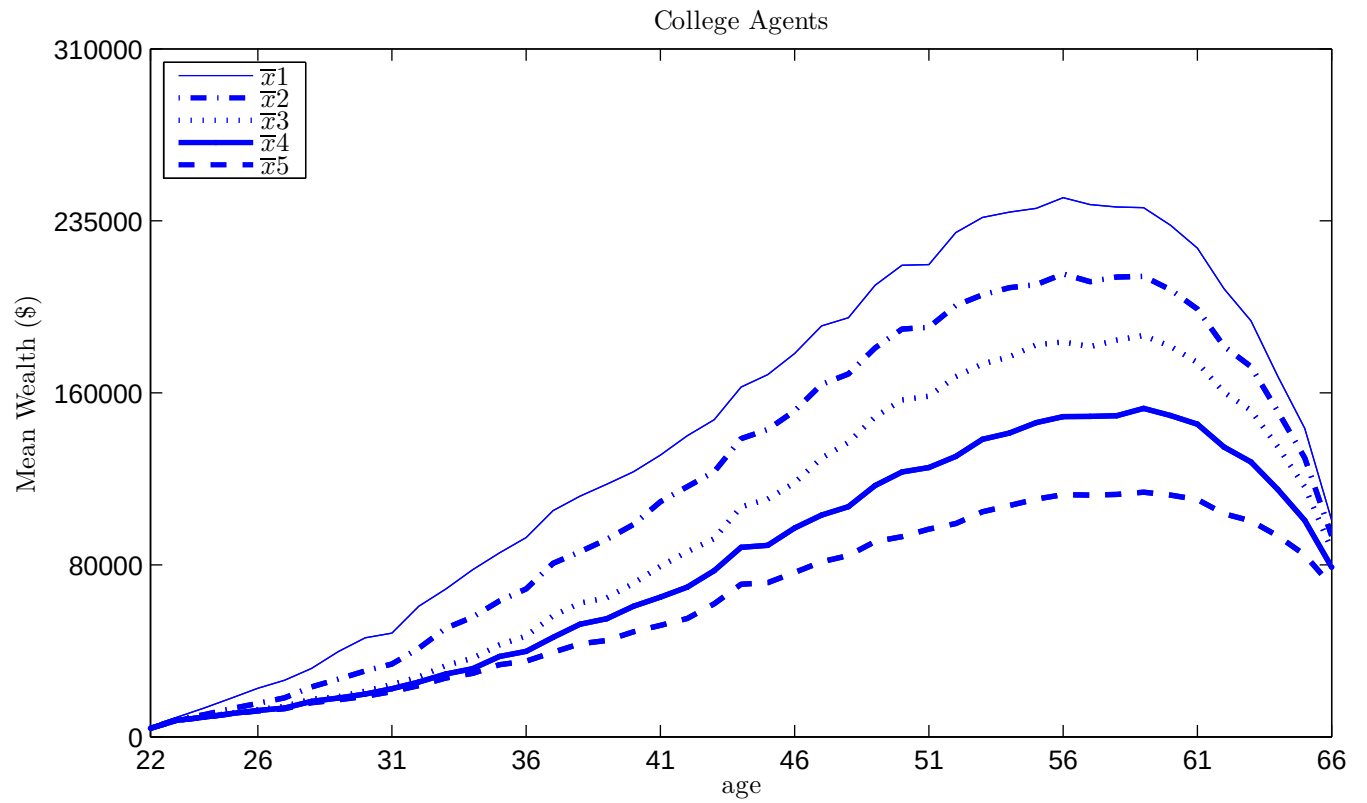


Figure 2: Mean Wealth given Age

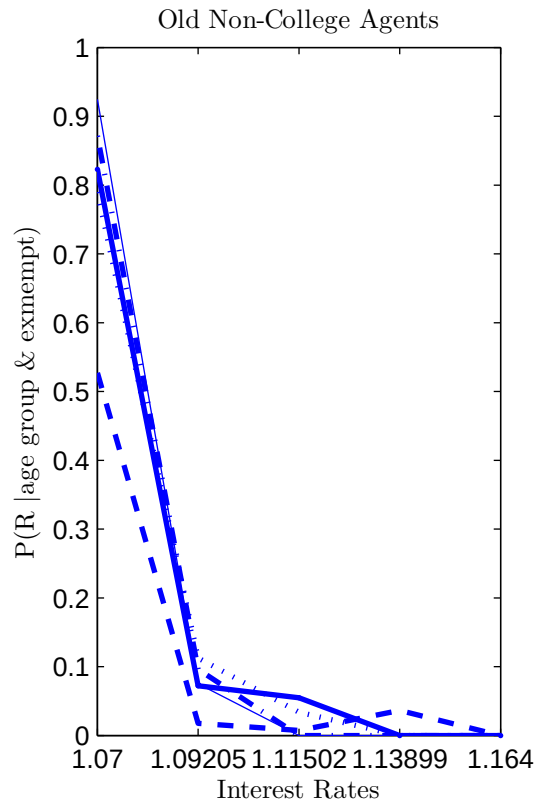
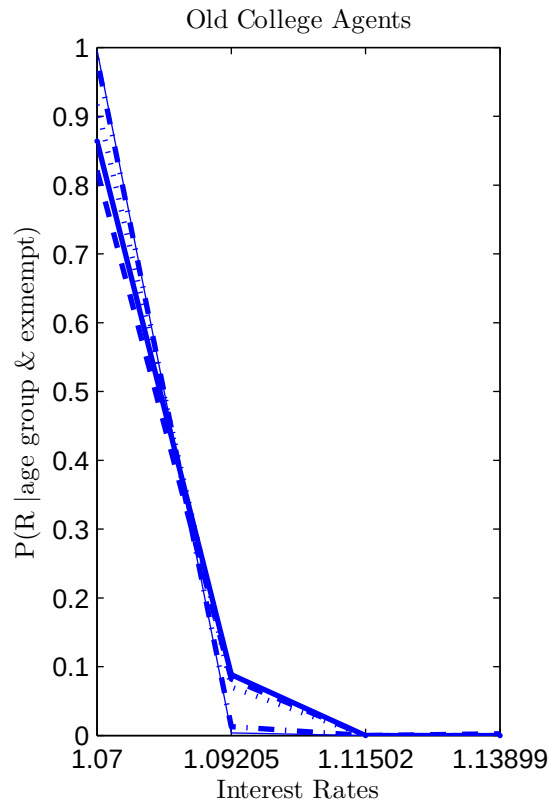
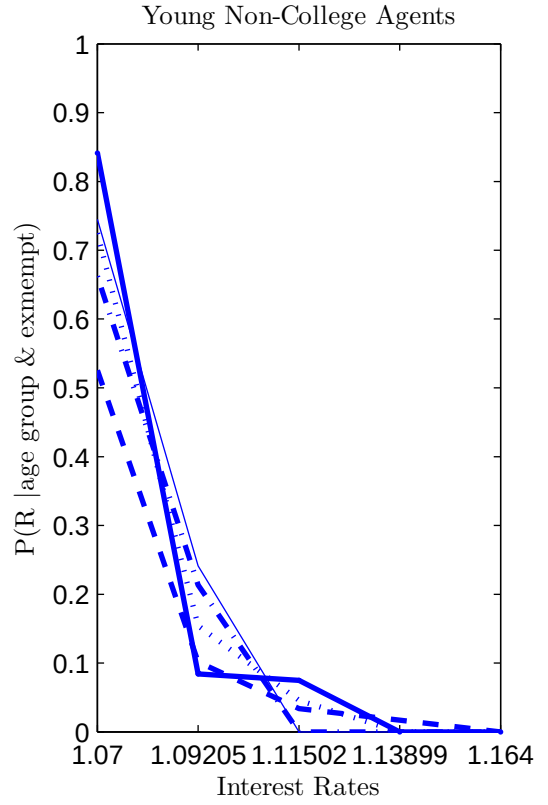
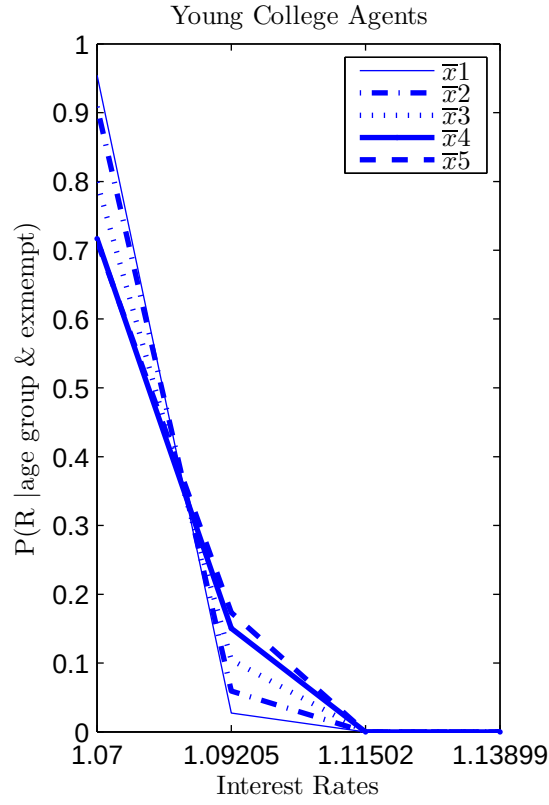


Figure 3: Loan Pricing along Equilibrium Path

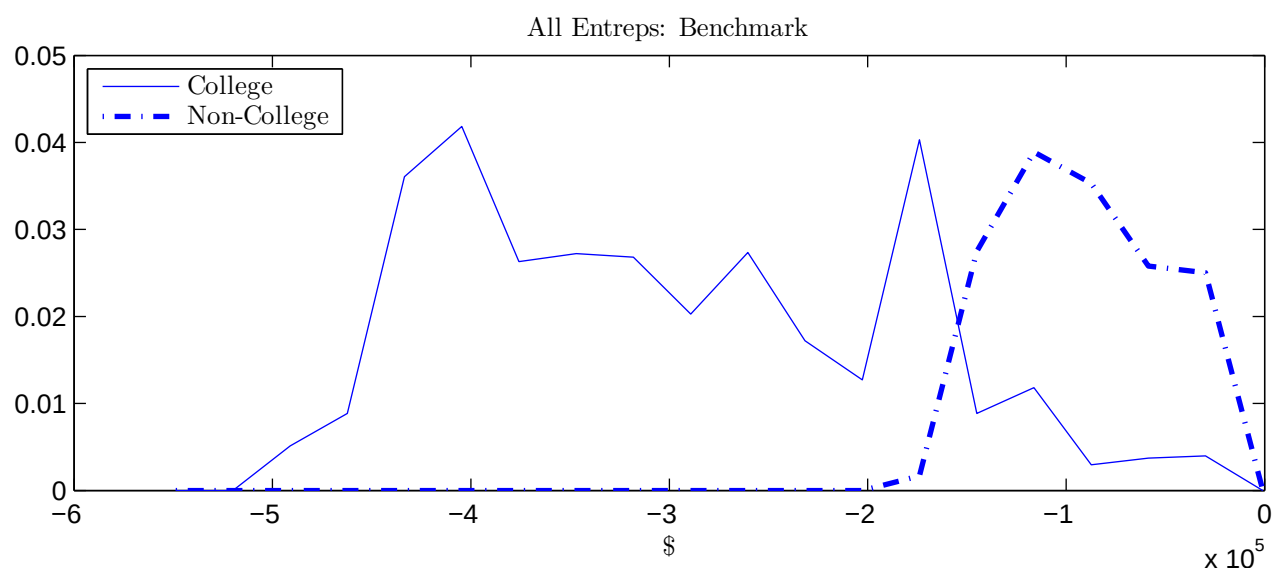
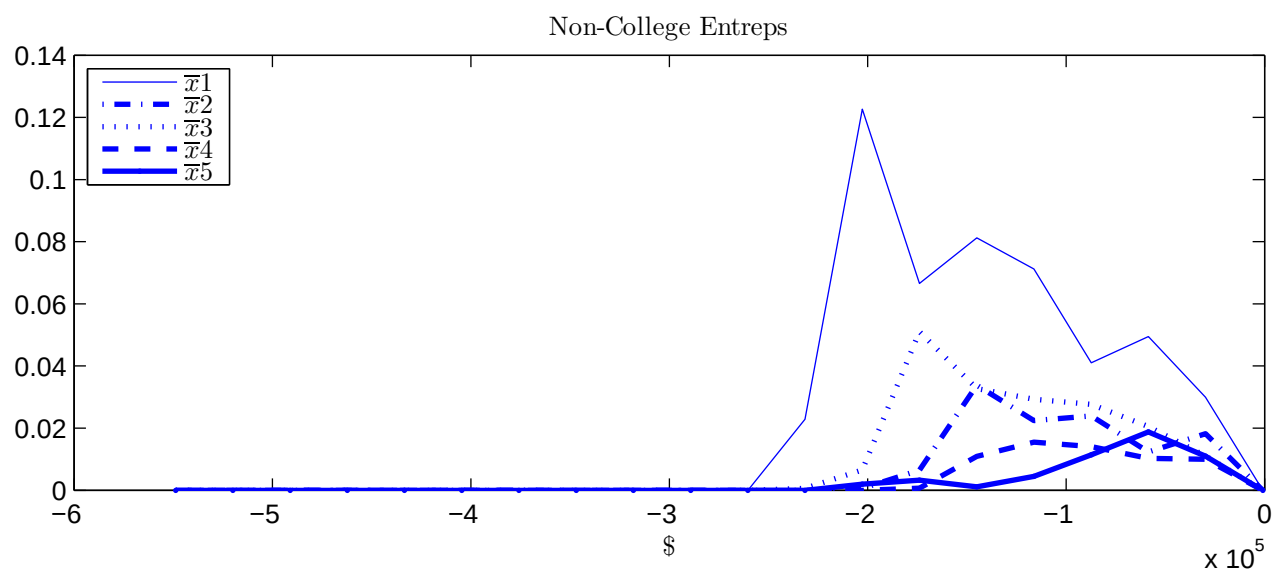
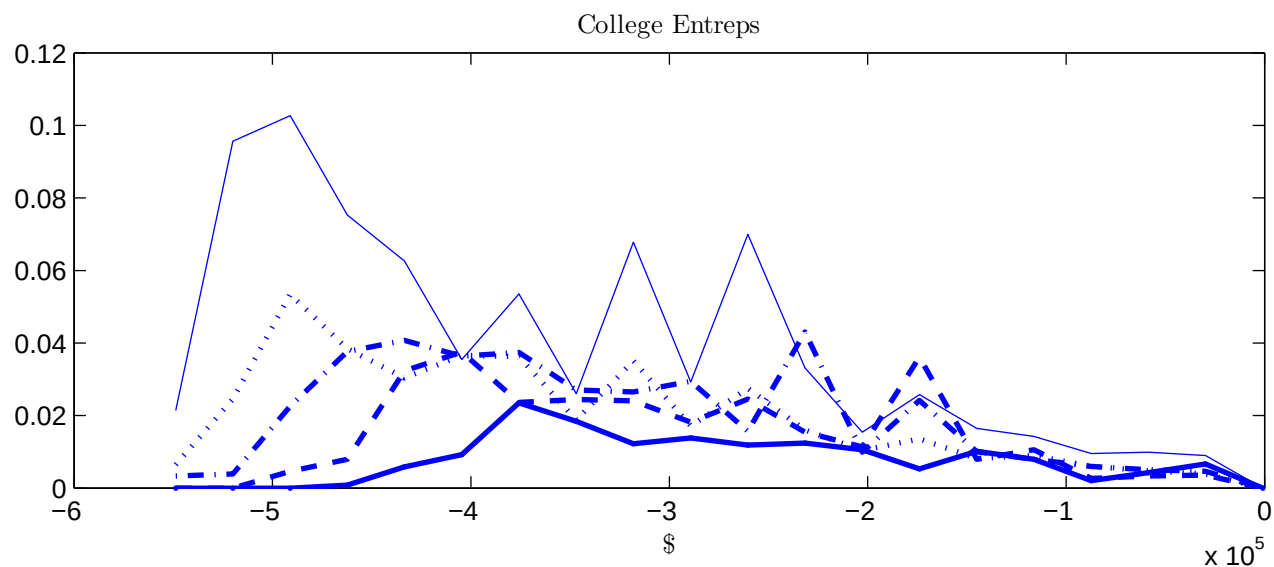


Figure 4: Distribution of Equilibrium Debts

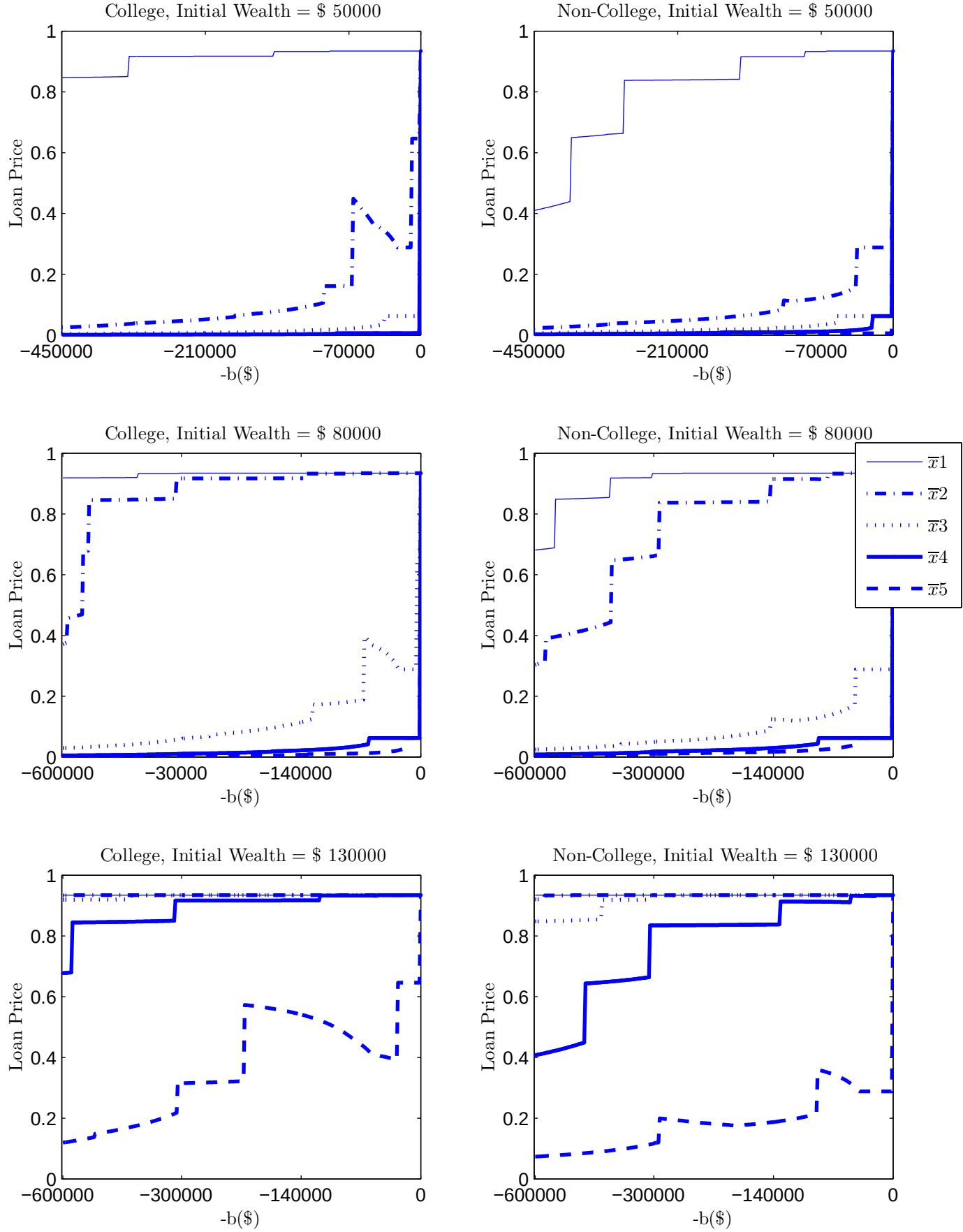


Figure 5: Loan Pricing

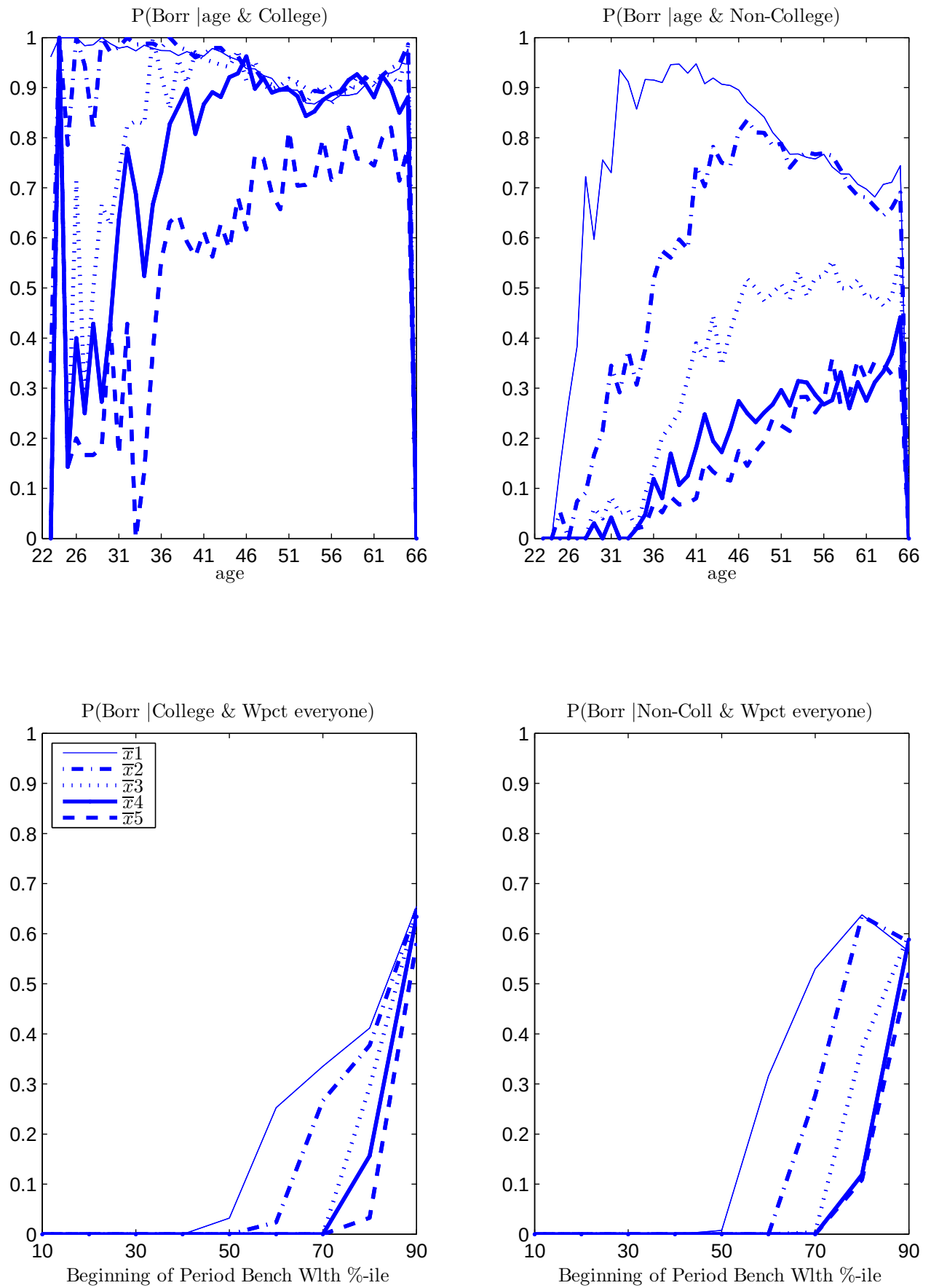


Figure 6: Probability of Entrepreneurial use of Credit Market

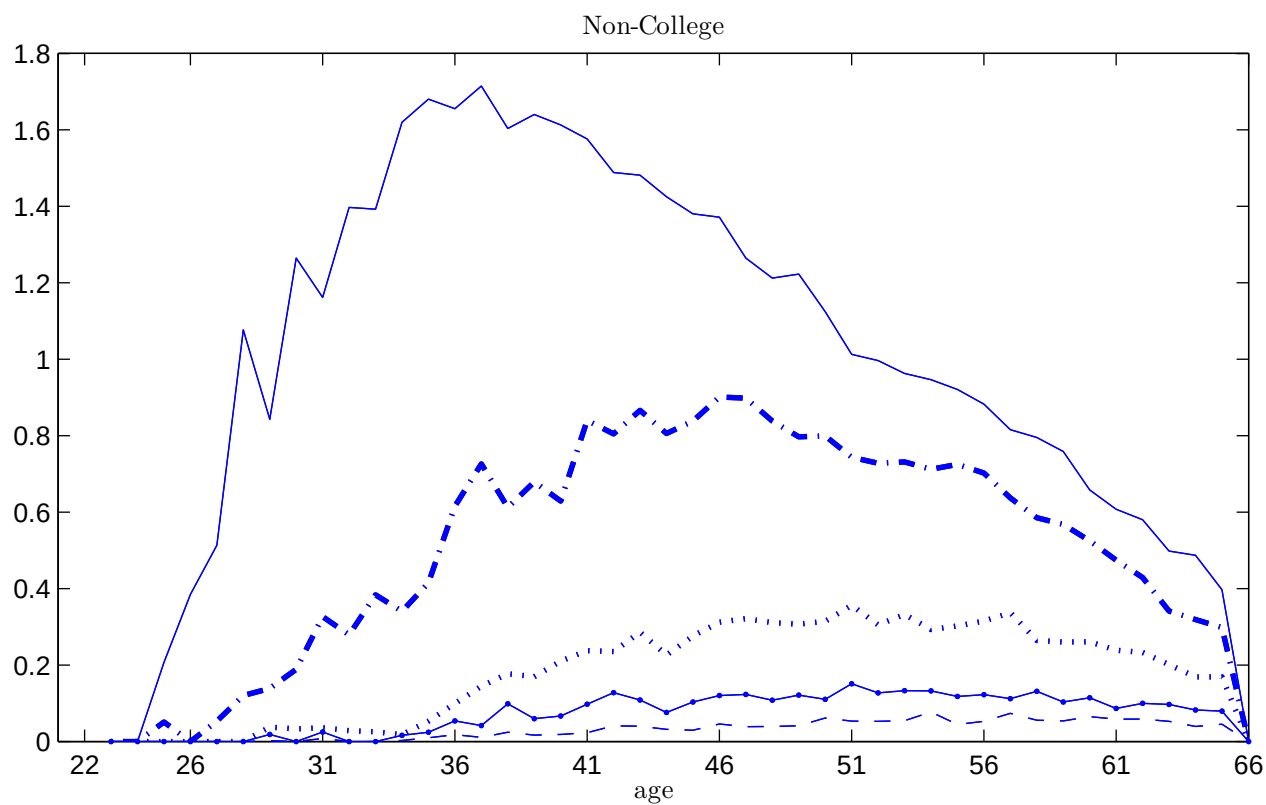
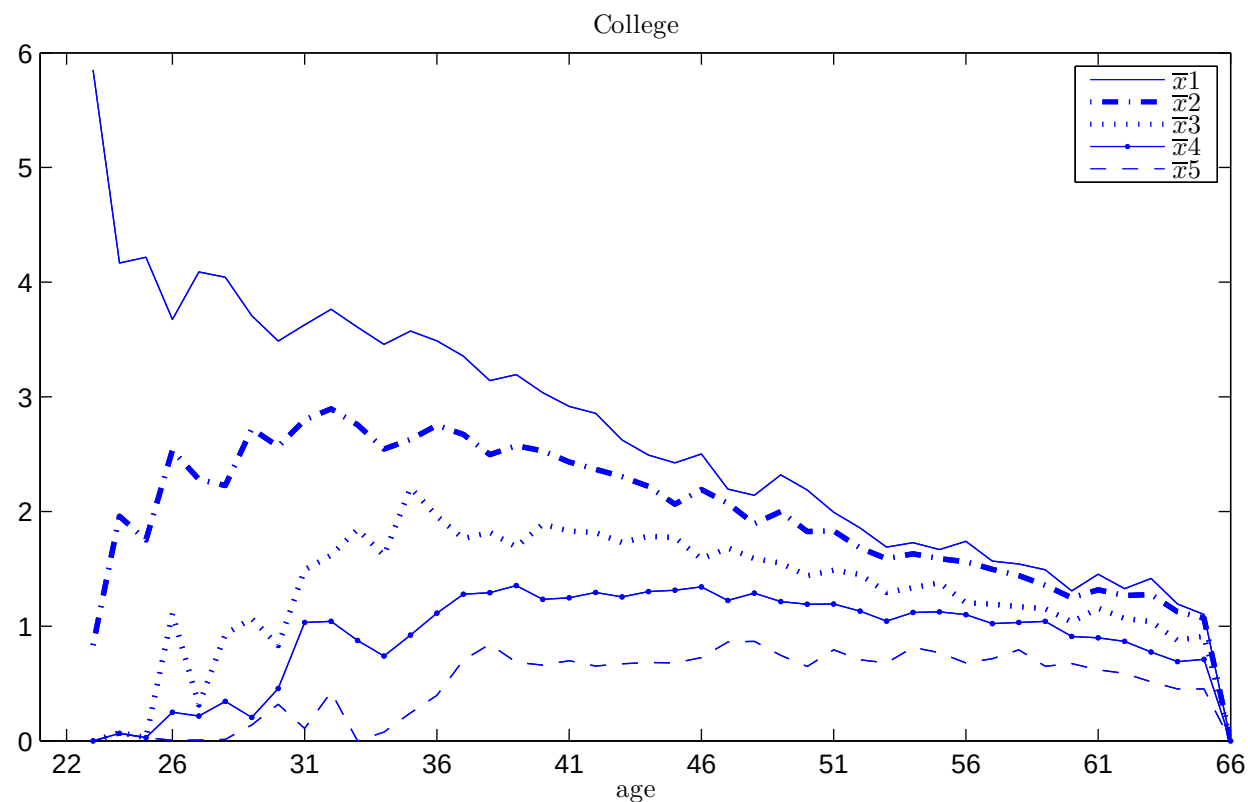


Figure 7: Expected Debt Equity Ratio given Age

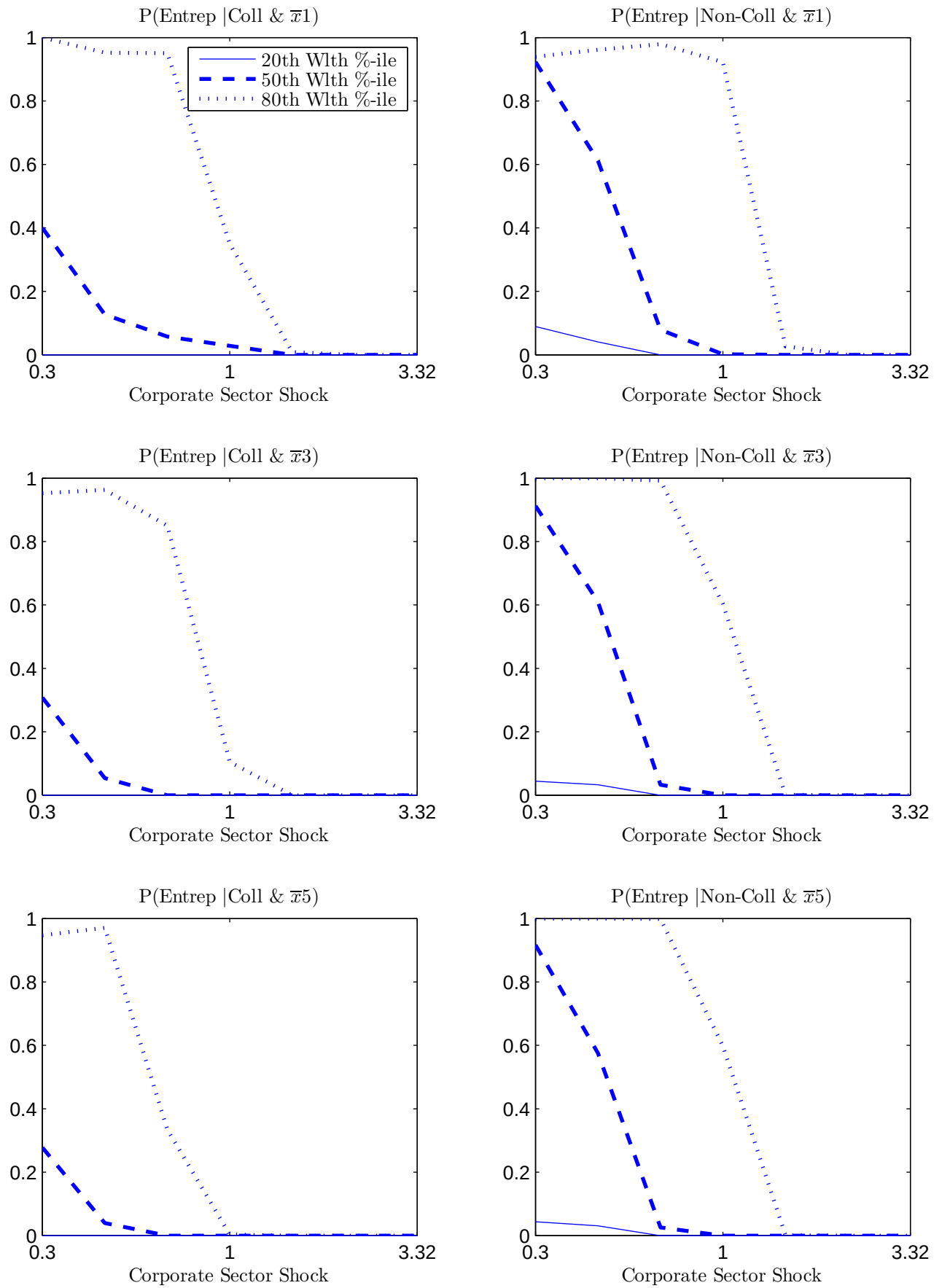


Figure 8: Probability of Entrepreneurship given Exemption Level and Corporate Sector Shock

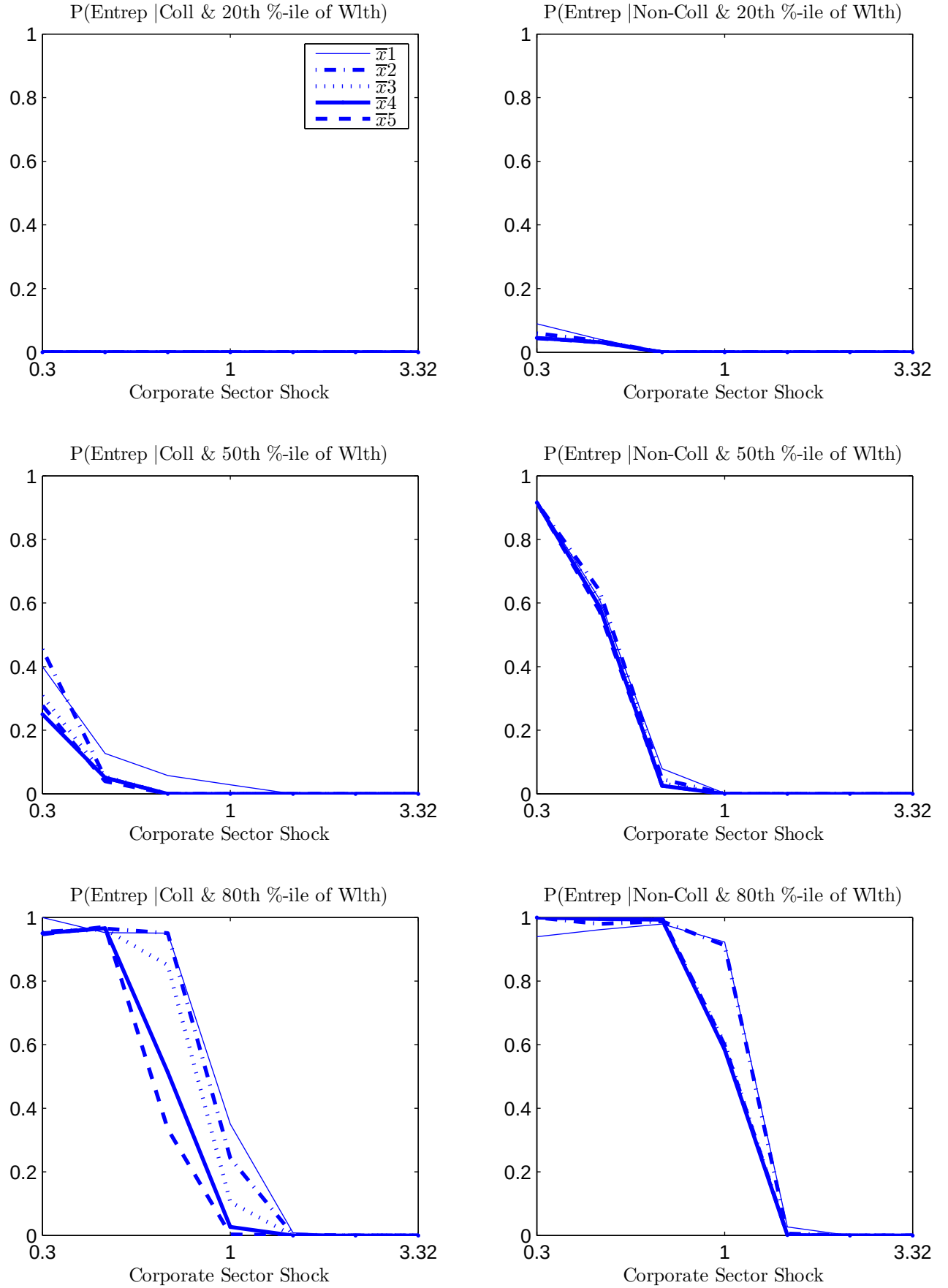


Figure 9: Probability of Entrepreneurship given Wealth Percentile and Corporate Sector Shock

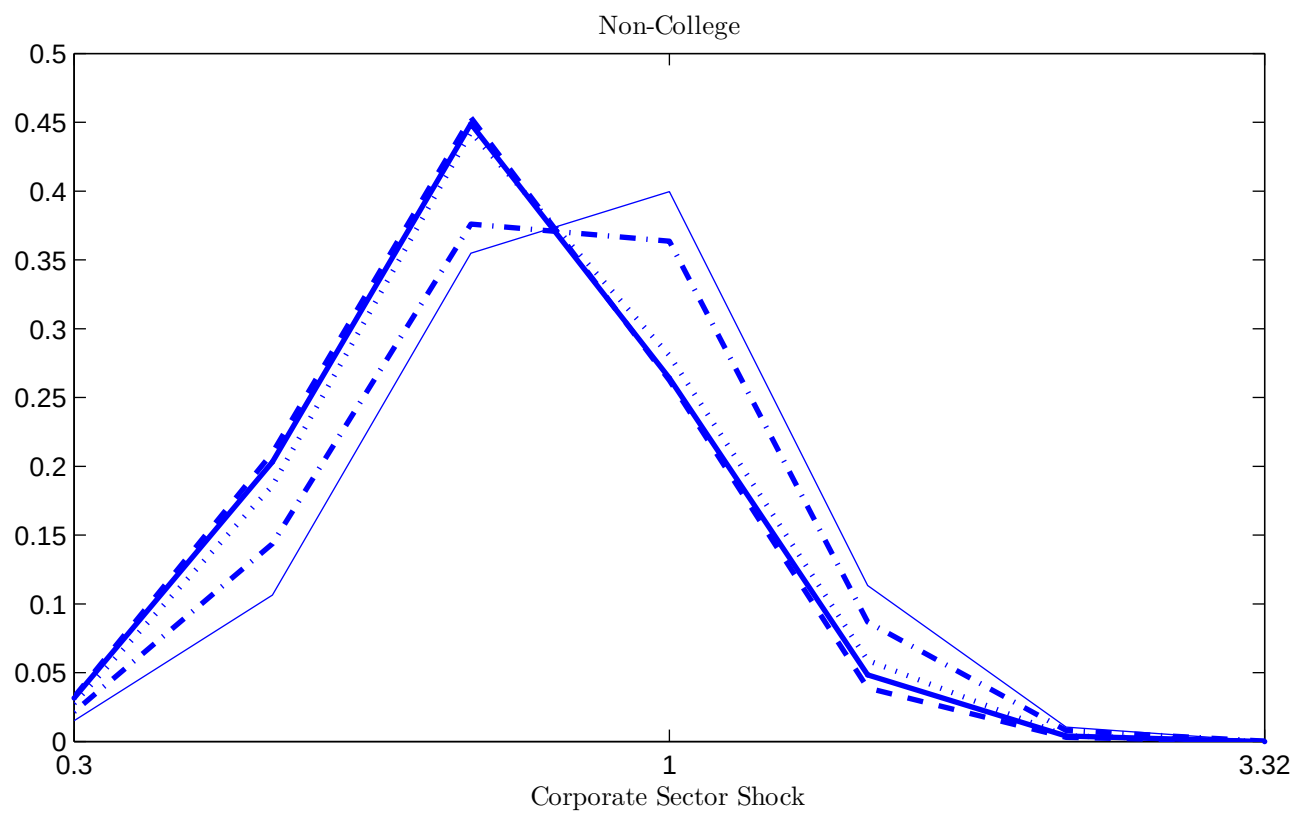
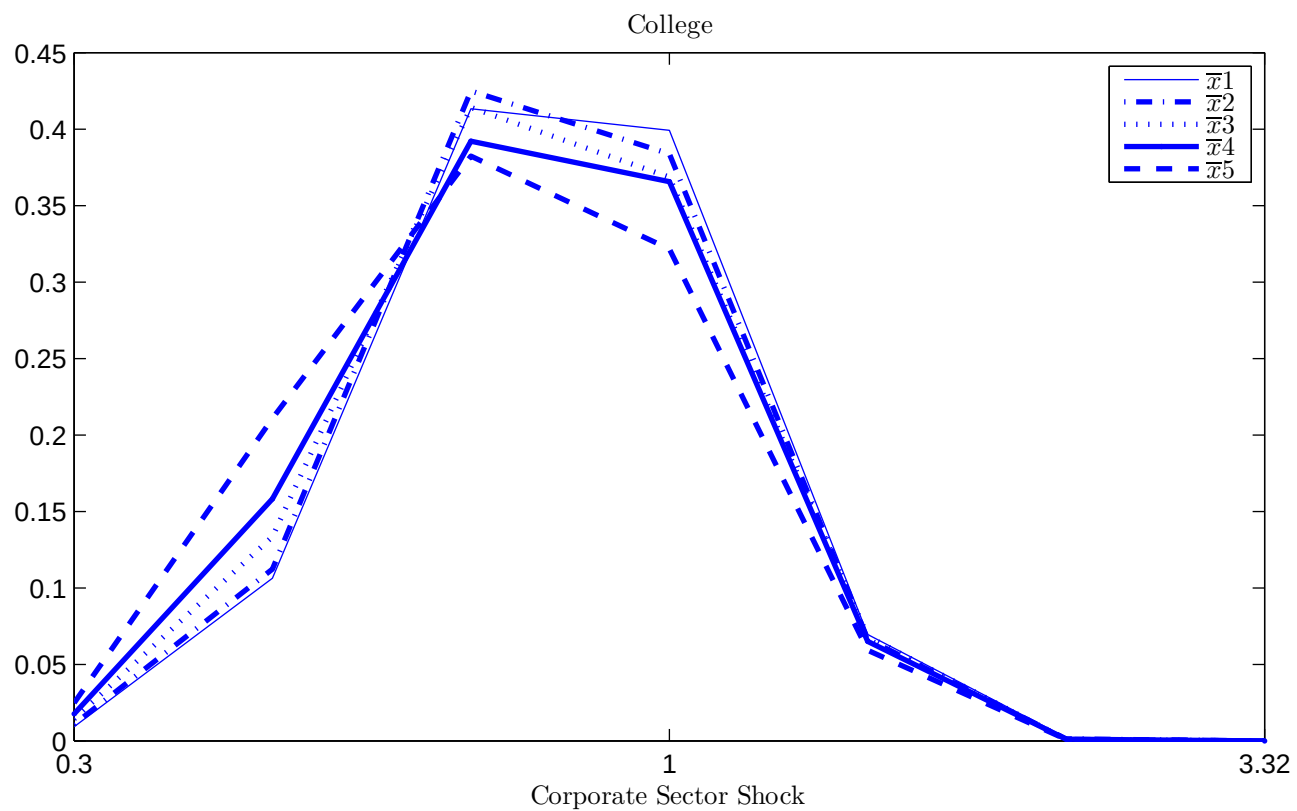


Figure 10: Probability of Corporate Sector Shock given Entrepreneurship

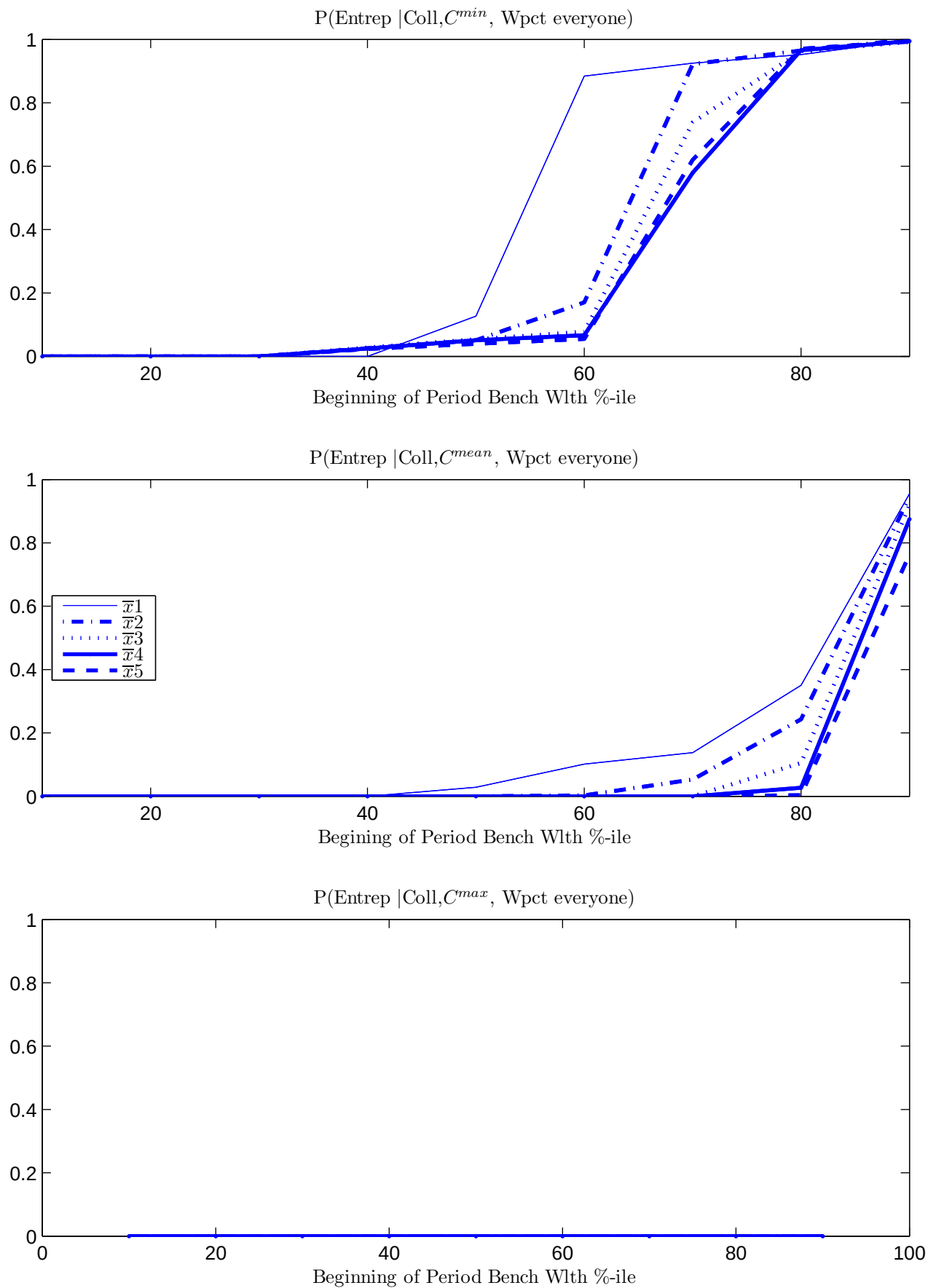


Figure 11: Probability of Entrepreneurship given College and Corporate Sector Shock

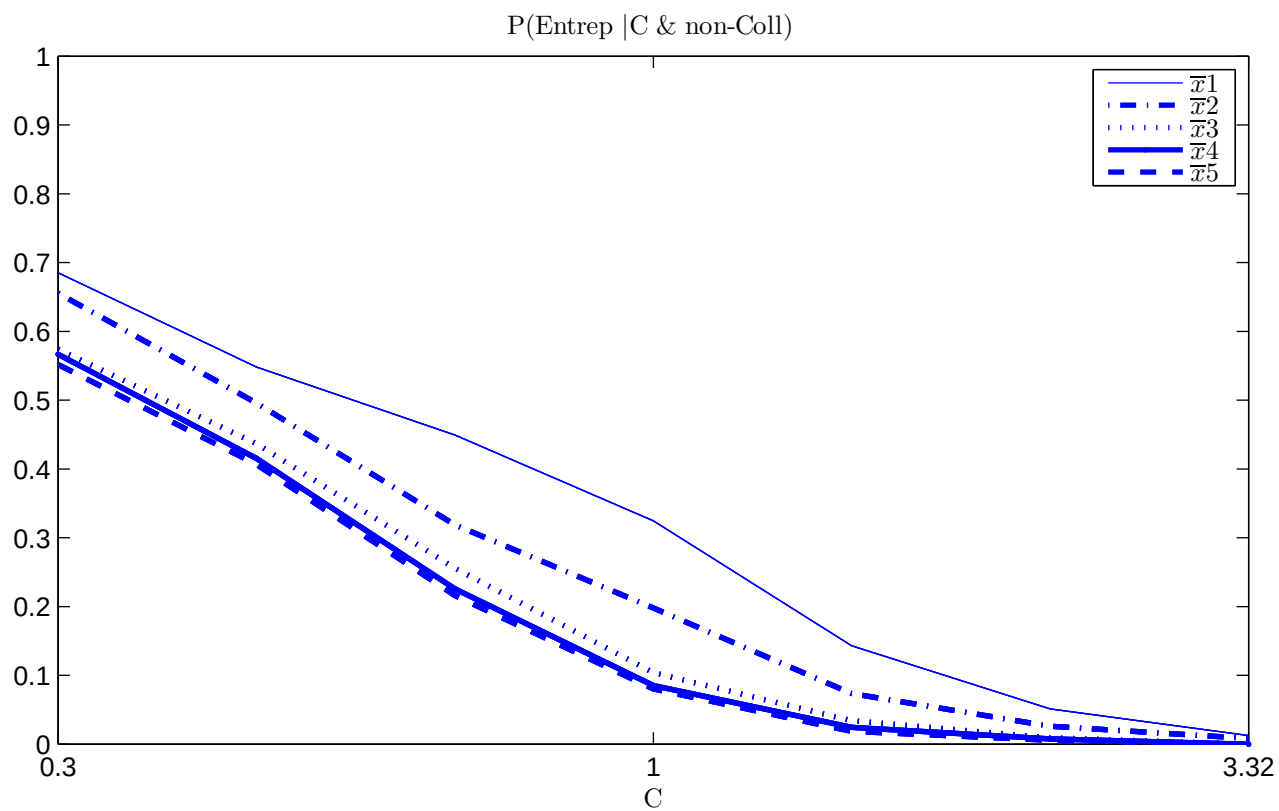
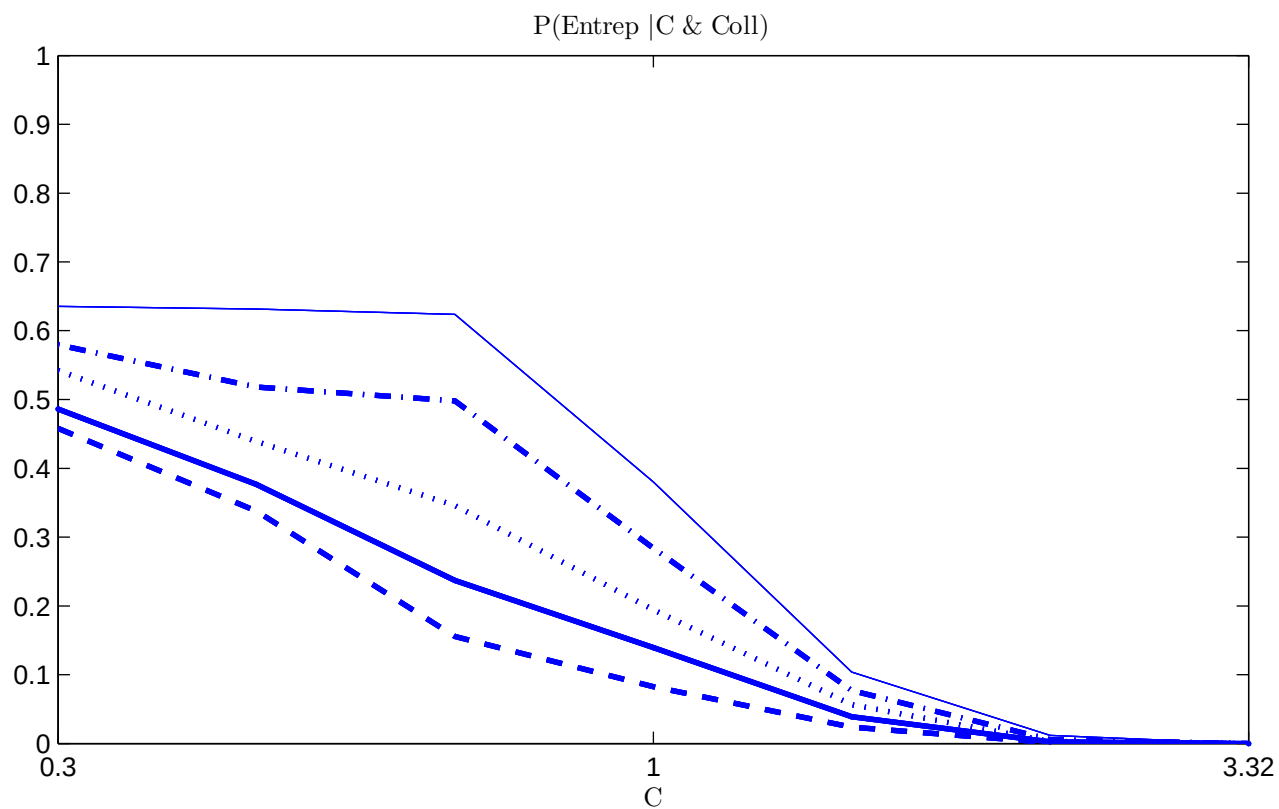


Figure 12: Unconditional Probability of Entrepreneurship Across Corporate Sector Shocks

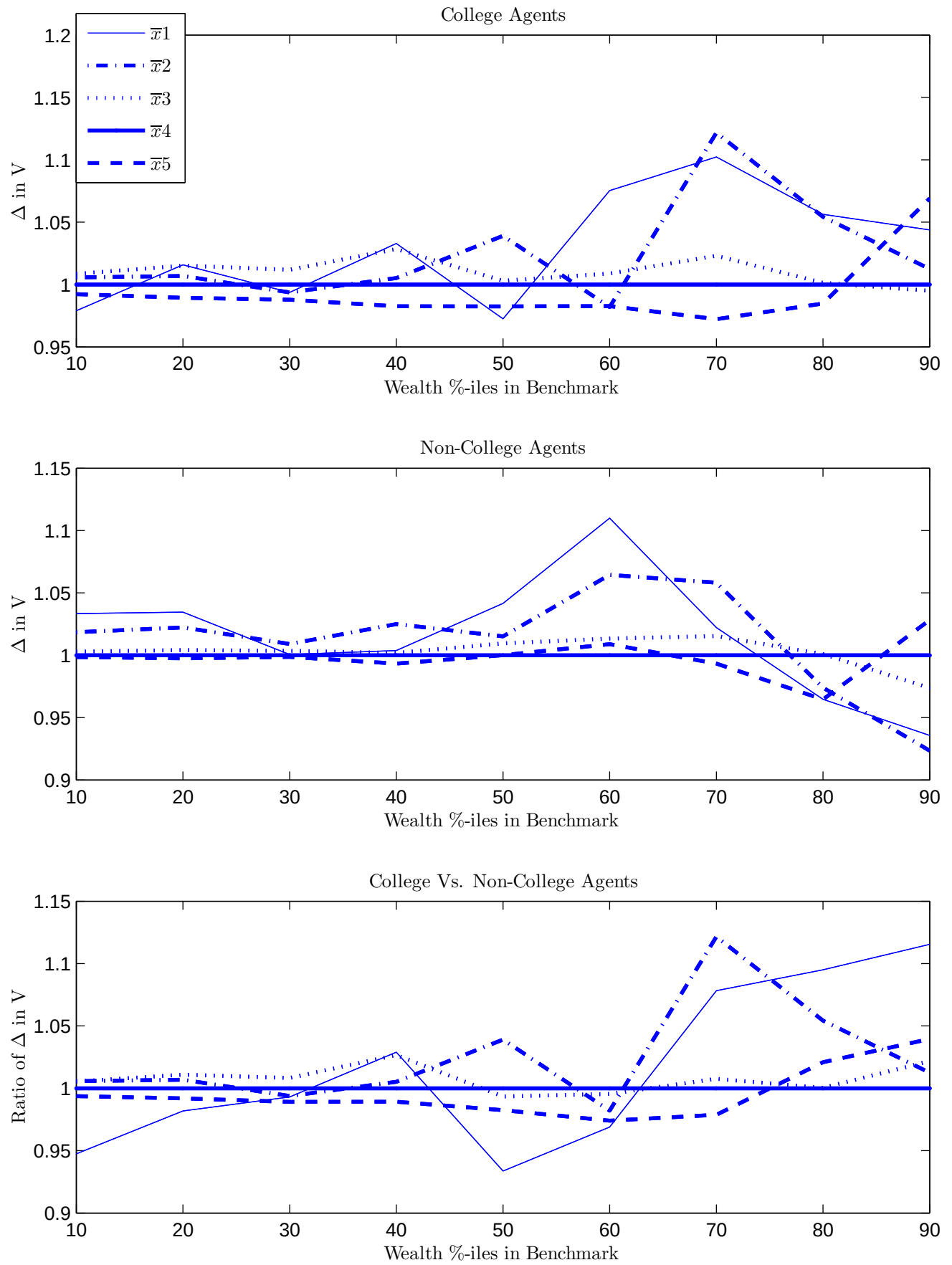


Figure 13: Changes in Value relative to Benchmark

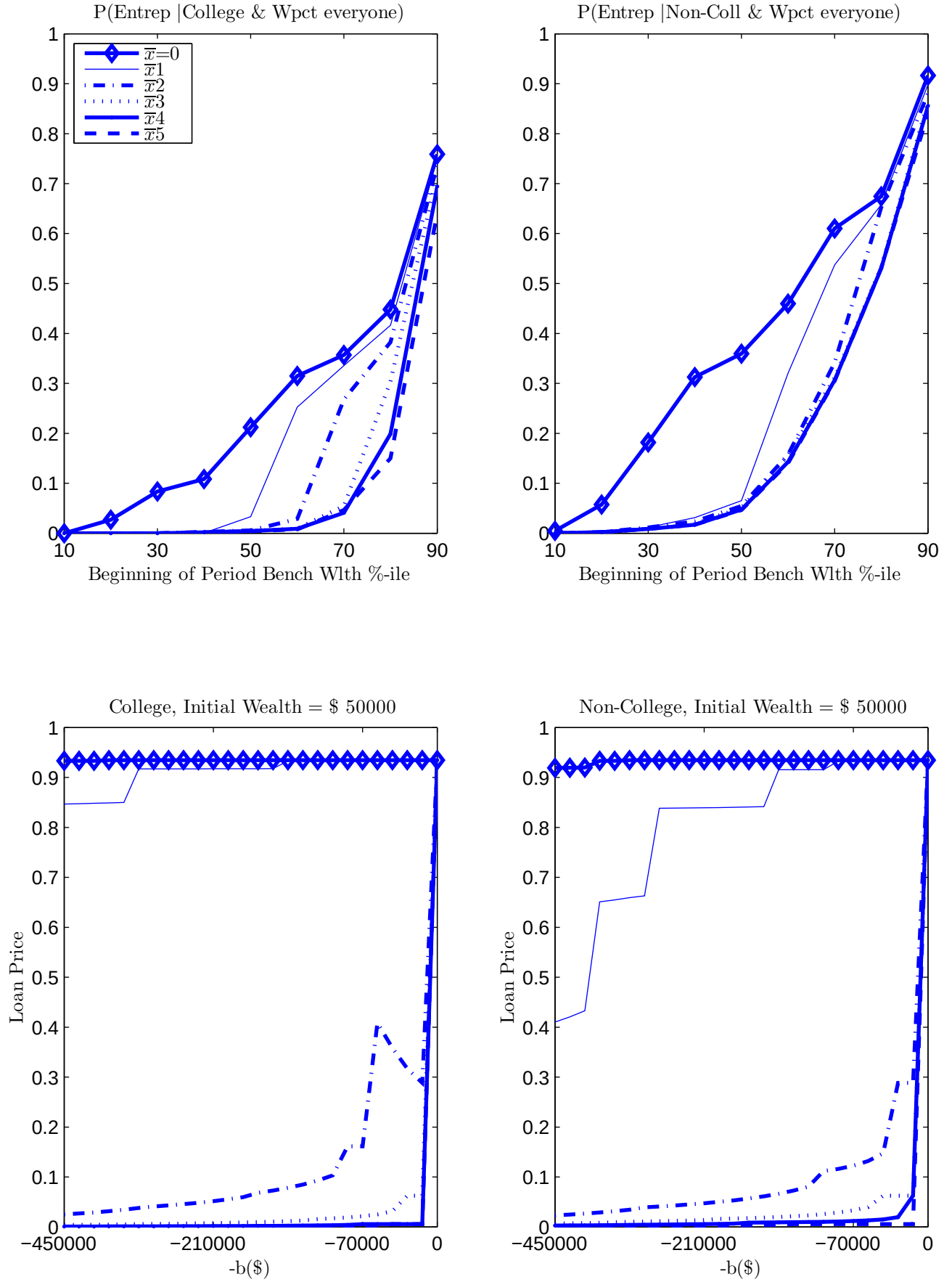


Figure 14: Zero Exemptions