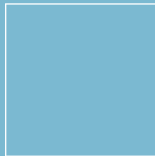




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# Are Harsh Penalties for Default Really Better?\*

Kartik Athreya  
Research Department  
Federal Reserve Bank of Richmond

Xuan S. Tam  
Department of Economics  
University of Virginia

Eric R. Young  
Department of Economics  
University of Virginia

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## Abstract

How might society ensure the allocation of credit to those who lack meaningful collateral? Two very different options that have each been pursued by a variety of societies through time and space are (i) relatively harsh penalties for default and, more recently, (ii) loan guarantee programs that allow borrowers to default subject to moderate consequences and use public funds to compensate lenders. The goal of this paper is to provide a quantitative statement about the relative desirability of these responses. Our findings are twofold. First, we show that under a wide array of circumstances, punishments harsh enough to ensure all debt is repaid improve welfare. With respect to loan guarantees, our findings suggest that such efforts are largely useless at best, and substantially harmful at worst. Generous loan guarantees virtually ensure substantially higher taxes – with transfers away from the non-defaulting poor to the defaulting middle-class – and greater deadweight loss from high equilibrium default rates. Taken as a whole, our findings suggest that current policy toward default is likely to be counterproductive, and that guarantees for consumption loans are not the answer.

**Keywords:** *Unsecured Credit, Penalties, Bankruptcy*

**JEL Classification Codes:** *D91, E21.*

If a man be taken in execution, and lie in prison for debt, neither the plaintiff, at whose suit he is arrested, nor the sheriff who took him, is bound to find him meat, drink, or clothes; but he must live on his own, or on the charity of others; and if no man will relieve him, let him die in the name of God, says the law; and so say I.

Justice Sir Robert Hyde, quoted in Baird (2001)

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# 1 Introduction

How might society ensure the allocation of credit to those who lack meaningful collateral? Two very different options that have each been pursued by a variety of societies through time and space are (i) relatively harsh penalties for debt default and, more recently, (ii) loan guarantee programs that allow borrowers to default subject to moderate consequences and use public funds to compensate lenders. These two routes are likely to have different welfare implications. Harsh penalties, by ensuring that competitive lenders are forced to make loans at or near the risk-free rate, expand access to credit. Nonetheless, to the extent that borrowers face uninsurable risks, harsh penalties also make borrowing risky, as debt must be paid irrespective of a debtor's *ex post* situation. Loan guarantees, by contrast, allow borrowers to default while protecting them from the costs of default that would otherwise surface in the terms on which they acquire credit. However, publicly funded loan guarantee programs require resources to make lenders whole *ex post*, and more importantly perhaps, may lead to significant misallocation of credit by decoupling the price of credit from the risk of default.<sup>1</sup> Recent changes in U.S. law also relax the link between the risk of default and the price of credit; for example, the Credit Card Accountability, Responsibility, and Disclosure (CARD) Act limits the lenders' ability to alter terms of credit in response to changes in borrower risk.

We define a penalty (or punishment) as any *ex post* default cost that destroys resources rather than transferring them from borrowers to lenders.<sup>2</sup> With respect to the use of penalties, Zame (1993) and Dubey, Geanakoplos, and Shubik (2005) demonstrate theoretically that if markets are incomplete at the outset, defaultable debt can play a role in supplementing extant markets. The intuition relies on the idea that debt forgiveness in the face of *ex ante* uninsurable misfortune relieves households of what might otherwise be crushing debt burdens. Dubey, Geanakoplos, and Shubik (2005) show in particular that penalties may be too "lax," but can also be too "strict." That is, penalties may be set so low that they allow default to happen "too" often and create deadweight losses, both from the *ex post* punitive action and from a pecuniary externality operating through interest rates. Conversely, very harsh *ex post* penalties can damage risk-sharing by removing state-contingency in the debt issued by households. As a result, welfare could be maximized by a choice of more "intermediate" penalties – ones that allow for default in equilibrium.<sup>3</sup>

The view of personal bankruptcy as an insurance scheme actually predates any justification rooted in formal economic theory. As a matter of practice, U.S. law has not harshly penalized those who default on unsecured debt and has instead allowed for the relatively easy discharge of unsecured debts for more than a century, under precisely the premise of providing relief to the "honest but unfortunate" debtor (Jackson 2001). Recently, several papers have used the insights of the theory discussed above in order to study the implications of penalty-based default policies in quantitatively-serious settings. In particular, these models share in common the analysis of dynamic consumption-savings problems in which households cannot fully insure risks to labor income and sometimes to "expenses."<sup>4</sup> In this literature, access to unsecured consumer credit markets has potentially large welfare consequences. Athreya, Tam, and Young (2008, 2009) compare allocations emerging from credit markets in which default on uncollateralized debt is allowed, with outcomes when all debt

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<sup>1</sup>Such programs need not be explicit: recent events in US housing markets have generated policy actions aimed at compensating lenders *ex post*, while allowing borrowers to default on debts. To the extent that some of these actions were anticipated, the logic of our analysis will apply.

<sup>2</sup>In contrast, the term *collateral* is restricted to *ex post* which transfer resources from borrowers to lenders.

<sup>3</sup>Moreover, as formalized in Kehoe and Levine (1993), lax penalties may themselves generate market incompleteness if the only "deep" reason for market incompleteness is limited commitment.

<sup>4</sup>Important landmarks in this literature include Chatterjee *et al.* (2005) and Livshits, MacGee, and Tertilt (2007).

must be repaid. A key finding in the latter is that the debts that households incur when they may borrow at the risk-free rate is far larger than what is observed. In other words, the ability of U.S. households to default on uncollateralized loans has led to its price being high and its use being low relative to the counterfactual that perfectly enforces repayment. As a result, the differential trajectories in unsecured debt over the life cycle under these two repayment regimes leads to consumption smoothing patterns that differ significantly. In terms of welfare, the “no-default” regimes generate substantially higher *ex ante* welfare (on the order of 1 percent of lifetime consumption).

The existence of the welfare gains from intermediate penalties in Dubey, Geanakoplos, and Shubik (2005) depends on the ability of borrowers of differential default risk to be pooled together and thereby not pay the *individually* actuarially fair price for their debt issuance. However, in a quantitative setting where pooling is imposed, Athreya (2002) finds that welfare is highest when penalties are set to eliminate equilibrium default; Mateos-Planas and Seccia (2006) find the same result. More recently, in a setting where private information allows for equilibrium pooling, the findings of Athreya, Tam, and Young (2009) suggest again that defaultable debt is *unlikely* to be able to function as a form of insurance. This result is quantitative; agents are modeled as issuing short-term debt and facing creditors who lack commitment to longer-term loans. In turn, households’ terms of credit change at the same frequency at which they receive shocks. Given the very high persistence of labor income shocks estimated by the literature, the repricing of unsecured credit implies that interest rates will be high for those who pose significant default risk. In effect, short-term defaultable debt is too “*ex post*” to be useful as insurance.<sup>5</sup> Tam (2009) extends this result to longer-term arrangements; specifically, he finds that competitively priced longer-period debt (in which the pricing function is held fixed over a number of periods) is welfare-dominated by one-period debt.

The preceding suggests that penalties sizeable enough to preclude all equilibrium debt default will improve allocations, often nontrivially. Yet, in modern societies, the clear trend has been to move away from such policies. No OECD nation currently has any of the once legally codified commitments to imprison, flog, “bawlerize,” or mutilate debtors in default.<sup>6</sup> In the U.S. alone, all but one in a sequence of recent Bankruptcy Reform Acts have weakened filing requirements, and even the most recent one does not move far in the reverse direction and – more importantly – largely eschews purely “punitive” measures. While real filing costs have been rising, these costs are often waivable and primarily consist of avoidable legal fees associated with attorneys. Discussion of the trends in bankruptcy consequences can be found in a number of works, including Efrat (1998, 2002), Moss (2000), West (2003), and Robe, Steiger, and Michel (2006).

The systematic relaxation of punitive measures mentioned above has been simultaneously accompanied by a trend in the direction of issuing loan guarantees on behalf of borrowers. Loan guarantees ensure that borrowers retain the state-contingency provided by defaultable debt, while simultaneously protecting them from facing the *ex post* actuarially fair price of this insurance. An implicit recognition of this reasoning may lie behind the observation that many societies employ loan guarantees (subject to eligibility requirements) to influence credit allocation to risky loans in sectors as diverse as loans for human capital, homes, and small business.<sup>7</sup> As an empirical mat-

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<sup>5</sup>An implicit assumption underlying these papers is that income must be *ex post* noncontractable so that contingent claims markets cannot function. In the presence of income verification (perhaps at a cost), the welfare gains from eliminating default options will likely be larger, since full contingency would be obtainable.

<sup>6</sup>*Bawlerizing* is a term denoting the practice of using a hired agent of the creditor to verbally abuse debtors at their place of work (see Michelman 1970). This agent was typically female and was known as a “bawlerout.” The practice was discontinued when it was discovered that employees were often fired when bawlerized, making them *less* likely to repay.

<sup>7</sup>In a different vein, Andolfatto (2002) argues informally that these two trends are likely to be related from a

ter, in the U.S. and many other developed nations loan guarantees are, in fact, perhaps the most important class of interventions in credit markets. Most obvious are the loan guarantee programs for home loans, such as FHA and VA loans. The U.S. Student Loan Administration (Sallie Mae) is active in arranging guaranteed loans, and the Small Business Administration's (SBA) 7a loan program is large as well. The SBA alone assisted small businesses in obtaining roughly \$100 billion in credit in the 1990s alone.<sup>8</sup>

Despite the prevalence of loan guarantees described above, in the U.S., there are no loan guarantees whatsoever on consumption loans. The complete absence of loan guarantees on consumer credit is striking: To the extent that the unsecured market is the one most relevant for improving the consumption smoothing efforts of the poor, their expansion to this sector could be consequential. Heuristically, consider a household borrowing \$10,000. The approximately ten-percentage-point difference in interest rates between an uncollateralized loan (such as a credit card) and a collateralized loan (such as a home equity loan) implies an additional cost from using unsecured credit of \$1000 annually. Moreover, as Calem, Gordy and Mester (2006) has noted, many U.S. households appear to use credit cards for relatively long-term financing, making the cost differential very likely a quantitatively important one.

The goal of this paper is to provide a quantitative statement about the relative desirability and effectiveness of (i) harsh penalties and (ii) loan guarantees in improving credit access, consumption smoothing, and welfare for those who possess little collateral. We employ a life-cycle consumption-savings model in which households face uninsurable, idiosyncratic risk in the tradition of Bewley (1977). Households face both intertemporal and intratemporal smoothing motives as their average labor productivity rises, and then falls after middle-age, while they are subject to shocks that consist of both a transitory and a persistent component. Insurance markets are assumed incomplete: households may save only in a risk-free asset and they can borrow only using debt that is non-contingent except when discharged in bankruptcy.

Our findings are twofold. First, we show that harsh penalties on default almost always improve welfare. Under a wide array of preference specifications and parameter settings, punishments harsh enough to ensure all debt is repaid make agents substantially better off *ex ante*. When taken together with the larger literature on consumer bankruptcy that shows that "catastrophes" are sufficient to justify lax default penalties, our findings suggest that catastrophes are likely to be *necessary* for bankruptcy to play a beneficial role for U.S. households. Second, with respect to loan guarantees, our findings suggest, surprisingly, that such efforts are largely useless at best and substantially harmful at worst. In particular, we find that when loan guarantees are not generous enough to fundamentally alter the "shape" of the loan-pricing functions faced by households, they cannot change substantially the level of debt taken in equilibrium. As a result, we show that loan guarantee programs cannot meaningfully influence allocations. Conversely, generous loan guarantees virtually ensure substantially higher taxes – with transfers away from the non-defaulting poor to the defaulting middle-class – and greater deadweight loss from high equilibrium default rates. The net effect is for welfare, in general, to decline with the generosity of loan guarantees.

Our work extends existing quantitative theory on unsecured consumer credit in two ways. First, our work provides the most comprehensive quantitative theory of the efficacy and desirability of default penalties that we know of. Second, our work is the first to systematically evaluate loan guarantee programs in a non-trivial model of default.<sup>9</sup> Allowing for default is clearly crucial in

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political economy standpoint: Lax bankruptcy rules create expensive credit, which then leads to calls for intervention via loan guarantees.

<sup>8</sup>See Weinberg and Walter (2002) and Li (2002) for more details. Both show that the overall contingent-liabilities of the US government have grown substantially over time.

<sup>9</sup>Li (2002) studies small-business loan guarantees but employs a stylized stochastic structure where output may

the evaluation of loan guarantees, given the centrality of default risk in creating a potential role for such programs. Moreover, the equilibrium approach taken in this paper is essential for understanding the likely implications of loan guarantees on consumption loans; because loan guarantees for consumption loans have not, to our knowledge, been used as public policy any purely empirical work seems impossible.

In analyzing default penalties, our work will focus on three specific issues: (1) the relative importance of preference-based motives for intertemporal and intratemporal smoothing, (2) household income risk, and (3) household uncertainty over income risk. With respect to the dependence of the implications of eliminating default via the imposition of high default costs on preferences, we are motivated by the work of Livshits, MacGee, and Tertilt (2007). These authors have argued that the fundamental tradeoff created by bankruptcy is between intertemporal and intratemporal smoothing. Understanding the relative importance of these motives therefore requires preferences that allow the two attitudes to be distinct, irrespective of the uncertainty surrounding income. However, all prior work has employed CRRA preferences which conflate the two aspects of household preferences. We therefore employ Epstein-Zin recursive utility (Epstein and Zin 1989), which we select due both to its tractability and demonstrated ability to improve the performance of asset pricing models, of which default debt is a special case.<sup>10</sup> There are of course many other preference structures that separate risk aversion and intertemporal substitution – we discuss some of these structures in the conclusion.

With respect to the dependence of the normative implications of high default costs on endowments, we are motivated by the well-known fact that the specification of income risk persistence crucially affects the ability of households to smooth marginal utility (see Deaton 1992). We therefore examine a wide class of earnings processes in which we allow the relative contributions of transitory and persistent shocks to vary widely. Here, we note that the current debate over the persistence and riskiness of labor income shocks (Guvenen 2007, Hryshko 2008, Guvenen and Smith 2009) renders an assessment of the role that persistence plays rather important.

Lastly, with respect to uncertainty over the nature of income risk itself, if households are not perfectly sure of the probabilistic structure of income risk, matters may be even more complicated. In particular, an idea that we pursue is that “ambiguity” about income risk may remove the tension between intra- and intertemporal smoothing noted above. As noted as early as Friedman (1957), agents will typically be unsure about the process that generates their labor income shocks, instead accepting that a family of potential distributions that may be difficult to distinguish are instead possible. Within this class of processes, an agent who displays ambiguity aversion (Epstein and Schneider 2003) or concern for misspecification (Hansen and Sargent 2007) will solve a max-min problem – the agent will choose the member of the class that makes utility lowest and then choose consumption and savings in order to deliver the highest utility in this worst case. It is precisely this feature of the problem that will allow for a more nuanced understanding of how penalties can be “excessive” and thereby welfare-reducing: bankruptcy elimination through harsh penalties may leave the agent unwilling to borrow at all. As a result, such a policy could perversely inhibit both intertemporal and intratemporal consumption smoothing, despite “mechanically” alleviating the limited commitment problem that the young and poor face. U.S. bankruptcy law appears directly predicated on the idea that penalties can indeed be “excessive,” in the sense that they may

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either be positive or zero. Default happens by definition if the latter state occurs, since repayment is impossible.

<sup>10</sup> The work of Backus, Routledge, and Zin (2007) shows that once risk aversion and intertemporal smoothing motives are separated, understanding who bears risk in a dynamic stochastic setting can be very counterintuitive. Specifically, these authors show that efficient allocations can involve infinitely-risk-averse agents holding most of the risky asset, while those unwilling to trade consumption intertemporally hold most of the assets with uneven intertemporal payoffs.

leave would-be borrowers unwilling to do so (see Jackson 2000). One innovation of our paper is to accommodate the possibility that harsh penalties will nontrivially suppress the demand for credit by allowing households to be ambiguity averse as in Klibanoff, Marinacci, and Mukerji (2009).

The potential role for ambiguity in driving the welfare implications of default policy is also suggested by the observation that in all extant work on consumer default, the beneficial effect of harsh penalties really depends on the “worst case” for household income (net of any uninsured expense shocks). In particular, the large welfare gains from harsh penalties in models without expense shocks stem from the ability of young agents to borrow out to the natural debt limit. The natural debt limit is, however, extremely sensitive to small changes in the value of the worst-possible labor income realization, particularly for (i) young agents for whom the annuity value of future labor income is particularly high, and (ii) all agents when the risk-free borrowing rate is low.<sup>11</sup> Since this lower bound is difficult to estimate accurately (see Deaton 1992 or Pemberton 1998), predicating an argument for eliminating bankruptcy on this welfare result seems scientifically hazardous.

In addition to the sensitivity of outcomes to the worst realization of income, those papers that have obtained welfare gains from keeping existing bankruptcy law have done so by appeal to “catastrophes” – unplanned pregnancies, divorces, and protracted illnesses – which push net worth into regions in which consumption sets would be *empty* without default. Such events are, like lower bounds on labor income, typically badly measured and may regularly conflate endogenous outcomes with exogenous shocks. This again raises the issue of the robustness of the case for avoiding strict penalties for default. Furthermore, the literature with catastrophic shocks also permits households to default without formally filing for bankruptcy, blurring the distinction between policy and a technological ability to “hide” oneself from creditors. Left unanswered is the following question: While apparently sufficient for bankruptcy to be useful, are catastrophes also *necessary*? Our study aims to shed light on this question.

## 2 Model

The general framework follows Athreya, Tam, and Young (2008, 2009). Households in the model economy live for a maximum of  $J < \infty$  periods. However, unlike Athreya, Tam, and Young (2008, 2009), we assume that the economy is small and open, so that the risk-free rate is exogenous, while the wage rate is still determined by a factor price condition.<sup>12</sup>

### 2.1 Households

Each household of age  $j$  has a probability  $\psi_j < 1$  of surviving to age  $j + 1$  and has a pure time discount factor  $\beta < 1$ . Households value consumption and attach a negative value  $\lambda_{j,y}$  (in terms of a percentage of consumption) to all nonpecuniary costs of filing for bankruptcy, which we permit

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<sup>11</sup>Denoting by  $y_{\min} > 0$  the lowest realization of potential labor income and  $r$  the risk-free interest rate on debt, the natural borrowing limit for an infinitely-lived agent is given by  $\underline{b}_{nat} \equiv -\frac{y_{\min}}{r}$ , a function that asymptotes to  $-\infty$  as interest rates go to zero. Assuming a credit card interest rate of 14 percent (the modal interest rate in SCF data in 1983 adjusted for a measure of realized inflation), the natural debt limit moves roughly seven times as much as the minimum income level. For good borrowers, for whom interest rate discounts have recently appeared (Furletti 2003, Athreya, Tam, and Young 2008, Livshits, MacGee, and Tertilt 2008), the natural debt limit will be even more sensitive.

<sup>12</sup>In our previous work we have introduced a class of “special” agents who hold lots of capital for the purpose of endogenously obtaining a low risk-free rate in the presence of low asset holdings for the median agent. Here, we ignore the general equilibrium determination of returns, and thus drop the special households from the model, because their presence is irrelevant to the question at hand.

to depend on type  $y$  to be defined below. Their preferences are represented by a utility function  $U\left(\left\{\frac{c_j}{n_j}\right\}_{j=1}^J\right)$  that we detail below for the two environments we study (Epstein-Zin preferences and ambiguity aversion preferences). We assume that households retire exogenously at age  $j^* < J$ .

We follow Chatterjee *et al.* (2007) in allowing for household-level costs from default that are primarily nonpecuniary in nature. The existence of nonpecuniary costs of bankruptcy are also suggested by the calculations and evidence in Fay, Hurst, and White (1998) and Gross and Souleles (2002), respectively. The former paper shows that a large measure of households would have “financially benefited” from filing for bankruptcy but did not, while both papers document significant unexplained variability in the probability of default across households even after controlling for a large number of observables. These results suggest the presence of implicit unobserved collateral that is heterogeneous across households including (but not limited to) any “stigma” associated with bankruptcy along with any other costs that are not explicitly pecuniary in nature (as in Athreya 2002). We will therefore sometimes refer to  $\lambda_{j,y}$  as stigma in what follows, although we intend it to be more encompassing.

The household budget constraint during working age is given by

$$c_j + q(b_j, I)b_j + \Delta \mathbf{1}(d_j = 1) \leq a_j + (1 - \tau)W\omega_{j,y}ye\nu, \quad (1)$$

where  $q$  is an individual-specific bond price that depends on bond issuance  $b_j$  and a vector of individual characteristics  $I$ ,  $a$  is net worth *after* the current-period default decision. Therefore,  $a_j = b_{j-1}$  if the household does not default and  $a_j = 0$  otherwise. Of central importance is  $\Delta$ , the pecuniary cost of filing for bankruptcy, which we will employ as our primary parameter governing default policy. The last term is after-tax current labor income. Log labor income is the sum of five terms: the aggregate wage index  $W$ , a permanent shock  $y$  realized prior to entry into the labor market, a deterministic age term  $\omega_{j,y}$ , a persistent shock  $e$  that evolves as an AR(1)

$$\log(e') = \varsigma \log(e) + \epsilon', \quad (2)$$

and a purely transitory shock  $\log(\nu)$ . Both  $\epsilon$  and  $\log(\nu)$  are independent mean zero normal random variables with variances that are  $y$ -dependent. The budget constraint during retirement is

$$c_j + q(b_j, I)b_j \leq a_j + vW\omega_{j^*-1,y}ye_{j^*-1}\nu_{j^*-1} + \Upsilon W, \quad (3)$$

where for simplicity we assume that pension benefits are composed of a fraction  $v \in (0, 1)$  of income in the last period of working life plus a fraction  $\Upsilon$  of average income (which is normalized 1). Because bankruptcy is not a retiree phenomenon, we deliberately keep the specification of retirees simple. There do not exist markets for insurance against income or survival risk and we abstract from any sources of long-run growth.

The survival probabilities  $\psi_{j,y}$  and the deterministic age-income terms  $\omega_{j,y}$  differ according to the realization of the permanent shock. We interpret  $y$  as differentiating between non-high school, high school, and college education levels, as in Hubbard, Skinner, and Zeldes (1994), and the differences in these life-cycle parameters will generate different incentives to borrow across types. In particular, college workers will have higher survival rates and a steeper hump in earnings; the second is critically important as it generates a strong desire to borrow early in the life cycle, exactly when default is highest. Less importantly they also face smaller shocks than the other two education groups. The life-cycle aspect of our model is key – in the data, defaults are skewed toward young households (who borrow at least in part for purely intertemporal reasons).<sup>13</sup>

<sup>13</sup>See Sullivan, Warren, and Westbrook (2000).



Non-pecuniary costs,  $\lambda$ , follow a two-state Markov chain with realizations  $\{\lambda_{L,y}, \lambda_{H,y}\}$  that are independent across households, but serially dependent with transition matrix

$$\Pi_\lambda = \begin{bmatrix} \pi & 1 - \pi \\ 1 - \pi & \pi \end{bmatrix}.$$

To limit free parameters, we assume that the transition probability matrix is symmetric and type-invariant, so the only difference across types in terms of stigma costs are their realizations. Our parametrization is more flexible than we used in previous work (Athreya, Tam, and Young 2008, 2009) so that we can match the default rates across education groups. As we show in a subsequent section, the process is still not flexible enough to match all the targets of interest, although it does a reasonable job.

## 2.2 Loan Pricing

We focus throughout on competitive domestic lending. There exists a competitive market of intermediaries who offer one-period debt contracts and utilize available information to offer individualized credit pricing. Let  $I$  denote the information set for a lender and  $\hat{\pi} : b \times I \rightarrow [0, 1]$  denote the function that assigns a probability of default to a loan of size  $b$  given information  $I$ .  $\hat{\pi}(b)$  is identically zero for positive levels of net worth and is equal to 1 for some sufficiently large debt level. The break-even pricing function satisfies

$$q(b, I) = \begin{cases} \frac{1}{1+r} & \text{if } b \geq 0 \\ \frac{(1-\hat{\pi}(b))\psi_j}{1+r+\phi} & \text{if } b < 0 \end{cases} \quad (4)$$

given  $\hat{\pi}(b)$ .  $r$  is the exogenous risk-free saving rate and  $\phi$  is a transaction cost for lending, so that  $r + \phi$  is the risk-free borrowing rate; the pricing function takes into account the automatic default by those households that die at the end of the period. We assume  $I$  contains the entire state vector for the household:  $I = (a, y, e, \nu, \lambda, j)$ . Zero profit for the intermediary requires that the probability of default used to price debt must be consistent with that observed in the stationary equilibrium, implying that

$$\hat{\pi}(b) = \sum_{e', \nu', \lambda'} \pi_e(e'|e) \pi_\nu(\nu') \pi_\lambda(\lambda'|\lambda) d(b(a, y, e, \nu, \lambda, j), e', \nu', \lambda'). \quad (5)$$

Since  $d(b, e', \nu', \lambda')$  is the probability that the agent will default in state  $(e', \nu', \lambda')$  tomorrow at debt level  $b$ , integrating over all such events *tomorrow* produces the relevant default risk. This expression also makes clear that knowledge of the persistent component  $e$  is critical for predicting default probabilities; the more persistent  $e$  is, the more useful it becomes in assessing default risk. For more details on the lending market, see Athreya, Tam, and Young (2008).

## 2.3 Government

The only purpose of government in this model is to fund pension payments to retirees. The government budget constraint is

$$\tau W \int y \omega_{j,y} e \nu \Gamma(a, y, e, \nu, \lambda, j < j^*) = W \int (\nu \omega_{j^*-1, y} y e_{j^*-1} \nu_{j^*-1} + \Upsilon) \Gamma(a, y, e, \nu, \lambda, j \geq j^*).$$

When we consider loan guarantee programs we will introduce a labor income tax intended to cover the cost of bailing out lenders.

## 2.4 Price Determination

We assume that the risk-free rate  $r$  is exogenous and determined by the world market for credit. Given  $r$ , profit maximization by domestic production firms implies that

$$W = (1 - \alpha) \left( \frac{r}{\alpha} \right)^{\frac{\alpha}{\alpha-1}}$$

where  $\alpha$  is capital's share of income in a Cobb-Douglas aggregate production technology.

## 2.5 Preferences

The recursive problems for the set of preferences we study are as follows.

### 2.5.1 Constant Relative Risk Aversion

The agent's problem is most standard under CRRA preferences, with the Bellman equation for a household of age  $j$  given by

$$\begin{aligned} v(a, y, e, \nu, \lambda, j) &= \max_{b, d(e', \nu', \lambda') \in \{0, 1\}} \left\{ n_j \left( \frac{c_j}{n_j} \right)^\rho + \beta \psi_{j, y}(EU) \right\} \\ EU &= \sum_{e', \nu', \lambda'} \pi_e(e'|e) \pi_\nu(\nu') \pi_\lambda(\lambda'|\lambda) V(b, y, e', \nu', \lambda', j+1) \\ V(b, y, e', \nu', \lambda', j+1) &= (1 - d(e', \nu', \lambda')) v(b, y, e', \nu', \lambda', j+1) + \\ &\quad d(e', \nu', \lambda') v^D(0, y, e', \nu', \lambda', j+1). \end{aligned} \tag{6}$$

The value function for a household that defaulted in the current period is given by

$$\begin{aligned} v^D(0, y, e, \nu, \lambda, j) &= \left\{ n_j \left( \lambda \frac{c_j}{n_j} \right)^\rho + \beta \psi_{j, y}(EU) \right\} \\ EU &= \sum_{e', \nu', \lambda'} \pi_e(e'|e) \pi_\nu(\nu') \pi_\lambda(\lambda'|\lambda) v(0, y, e', \nu', \lambda', j+1). \end{aligned} \tag{7}$$

$1 - \rho \geq 0$  is the coefficient of relative risk aversion and also the inverse of the elasticity of intertemporal substitution. Households cannot borrow or save during the period in which they declare bankruptcy; however, every household has the ability to declare bankruptcy in the periods following the default.<sup>14</sup>

### 2.5.2 Epstein-Zin

Under Epstein-Zin preferences, a household of age  $j$  solves the dynamic programming problem

$$\begin{aligned} v(a, y, e, \nu, \lambda, j) &= \max_{b, d(e', \nu', \lambda') \in \{0, 1\}} \left\{ n_j \left( \frac{c_j}{n_j} \right)^\rho + \beta \psi_{j, y}(EU)^{\frac{\rho}{1-\sigma}} \right\}^{\frac{1}{\rho}} \\ EU &= \sum_{e', \nu', \lambda'} \pi_e(e'|e) \pi_\nu(\nu') \pi_\lambda(\lambda'|\lambda) V(b, y, e', \nu', \lambda', j+1) \\ V(b, y, e', \nu', \lambda', j+1) &= (1 - d(e', \nu', \lambda')) v(b, y, e', \nu', \lambda', j+1)^{1-\sigma} + \\ &\quad d(e', \nu', \lambda') v^D(0, y, e', \nu', \lambda', j+1)^{1-\sigma} \end{aligned} \tag{8}$$

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<sup>14</sup>That is, exclusion from credit markets beyond the initial period is not sustainable as a punishment. We discuss punishments specifically in a subsequent section.

where

$$\begin{aligned}
v^D(0, y, e, \nu, \lambda, j) &= \left\{ n_j \left( \lambda \frac{c_j}{n_j} \right)^\rho + \beta \psi_{j,y} (EU)^{\frac{\rho}{1-\sigma}} \right\}^{\frac{1}{\rho}} \\
EU &= \sum_{e', \nu', \lambda'} \pi_e(e'|e) \pi_\nu(\nu') \pi_\lambda(\lambda'|\lambda) v(0, y, e', \nu', \lambda', j+1)
\end{aligned} \tag{9}$$

is the value of default.  $\sigma \geq 0$  governs the household’s aversion to fluctuations in utility across states of nature while  $\rho \leq 1$  controls the substitutability between current and future utility; specifically,  $\sigma$  is the coefficient of relative risk aversion with respect to gambles over future consumption and  $\frac{1}{1-\rho}$  is the elasticity of intertemporal substitution in consumption. When  $\rho = 1 - \sigma$  these preferences order stochastic streams of consumption in the same way as expected utility does, so that we nest the basic model.

### 3 Results

The results are organized into three subsections. First, we study the roles played by aversion to fluctuations in consumption over time and across states-of-nature. We begin with expected utility preferences; as is well-known, these preferences do not permit separate parametrization of agent attitudes toward intertemporal and intratemporal fluctuations. We then relax the tight link between aversion to intra- and intertemporal variability in consumption by employing Epstein-Zin preferences. Throughout this subsection, we consider parameter values that lie near the values implied by the benchmark calibration; these values ensure that model outcomes remain in congruence with cross-sectional facts on consumption and income inequality. We show that harsh penalties really are better, at least *ex ante*. Second, based on this result, we ask the “inverse” question: Are there economies in which harsh penalties are not welfare improving? In this subsection, we no longer restrict ourselves to parameters dictated by U.S. data; rather, our goal is to understand whether any parameterizations within the parametric classes we study are capable of generating lax bankruptcy as welfare improving policy. Specifically we consider shocks with counterfactually large persistent and transitory components and preferences that display ambiguity aversion. In the third and final subsection, we study the promise of loan guarantees as an alternative to harsh punishments.

#### 3.1 Are Harsh Penalties Really Better?

In this subsection, we evaluate the implications of harsh penalties for a variety of empirically plausible values for agent attitudes toward intra- and intertemporal consumption smoothing. At the outset it should be made clear that harsh penalties are already implicit in a great deal of work with life-cycle consumption-savings models: default is routinely ruled out by assumption. It is therefore clear that our model also nests benchmark life-cycle incomplete-markets models (such as Huggett 1996); when the penalties for default are zero no credit can be sustained, and when the penalties rule out default the natural borrowing limit prevails. Before evaluating alternatives, however, it is useful to understand why they must be a matter of policy rather than an endogenous outcome of decentralized trading arrangements. First, the most prevalent form of explicitly unsecured credit is that arising from the open-ended revolving debt plan offered by credit card lenders. Credit card lending, in turn, has been (certainly since the mid 1990s) extremely competitive.<sup>15</sup> The relevance

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<sup>15</sup>The average interest rate on credit card balances is high – currently 14 percent – relative to more secured forms of debt. As Evans and Schmalensee (1998) have pointed out, however, it is straightforward to “account” for the interest rate after funding costs, transactions costs, and most crucially, default costs are taken into account.

of the competitiveness of the U.S. unsecured lending industry is that the credit market cannot be punitive in its treatment of those who default. That is, no single firm would be willing to treat an individual borrower any worse than the current assessment of their state would justify. As a result, a household contemplating default in such a setting can safely rule out being “punished” for it. In the case where default conveys no additional information to a lender than what it was able to observe *a priori*, there is literally no change in terms that are “caused” by the act of renegeing on a payment obligation. Conversely, when default does reveal information, the change in terms is again not “punitive” in nature. As a result, “high” *ex post* interest rates following bankruptcy are implausibly ascribed to deadweight-loss-inducing penalties. Given the inability of competitive lenders to commit to punishments, penalties capable of sustaining unsecured credit markets are likely to require intervention by policy-making authorities.<sup>16</sup> In other words, in the market for unsecured consumer debt, it is likely that *penalties have to be policies*. In what follows we examine the role of penalties in determining credit use and consumption allocations.<sup>17</sup>

At the outset, we noted that for plausible parameterizations of preferences that admit an expected utility representation, policies that employ penalties harsh enough to eliminate default on the equilibrium path typically improve allocations. Our first step is to understand whether this argument for punishment obtains only because of the restriction to expected utility or is a more fundamental property of models of life-cycle consumption smoothing. The specific quantitative experiment we consider is the imposition of cost of default  $\Delta$  that is large enough to eliminate all default on the equilibrium path. Our results are divided into two subsections. Before proceeding, we note the following property of our model.

**Proposition 1** *For each  $(a, y, e, \nu, j)$  there exists  $\Delta$  large enough that  $\hat{\pi}(b) = 0$ .*

This result relies on the nonnegativity condition for consumption – if  $\Delta$  exceeds the labor income of the household in the current period, default cannot occur since consumption would have to be negative. Given that total labor income is bounded (by assumption) and borrowing is proscribed in the period of default, we can always impose a cost of filing sufficient to generate zero bankruptcy along the equilibrium path. We then compute the change in lifetime utility for each individual given a  $\Delta$  that exceeds the maximum required; in the absence of general equilibrium effects, we can compute these changes for each individual, rather than simply for newborns, without the need to track transitional dynamics. We will focus in general on *ex ante* welfare of newborns as our measure.

Our results are also computed under an assumption of full and symmetric information between borrowers and lenders. As we showed in Athreya, Tam, and Young (2008), asymmetric information leads to adverse selection effects that greatly increase the welfare costs of bankruptcy, so our results will be robust to the introduction of those features. We are cognizant of the regulatory environment in the U.S., where certain aspects of an individual’s state vector – race, gender, and age – are legally proscribed under the Equal Credit Opportunity Act from influencing the pricing

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<sup>16</sup>Most dynamic contracting models of limited borrower commitment, for example, currently use implicit or explicit appeals to public institutions with commitment to punish, in order to motivate penalties for the value of autarky (such as Ábraham and Carceles-Poveda 2008). In recent work, Krueger and Uhlig (2007) show that the inability of the supply side of the credit market to commit to punishments can have severe implications for the existence of the market itself. In the “normal” case, Krueger and Uhlig (2007) show that competition in fact collapses credit and insurance markets completely even without informational frictions.

<sup>17</sup>We want to be clear that what we call “penalties” differs from the usage in Ausubel and Dawsey (2008), where rates imposed after late or missed payments are labeled punitive. They attribute the high values of such rates to a common agency problem. Modeling the bilateral contracting problem that would arise in the presence of noncompetitive intermediation is well beyond the goals for this paper.

of unsecured debt.<sup>18</sup> Since we are studying the effects of this act in other work, we suppose that the full information environment is the appropriate vehicle for calibration.

### 3.1.1 Expected Utility

We consider a benchmark case of expected utility, where  $\rho = 1 - \sigma = -1$ . We choose  $(\beta, \lambda_{L,y}, \lambda_{H,y}, \pi)$  to match the default rates of each type  $y$ , the measure of negative net worth as a fraction of GDP for each type  $y$ , the fraction of borrowers, and the discharge ratio (mean debt removed via bankruptcy divided by mean income at time of filing). Table 1 contains the constellation of parameters that fits best (when viewed as exactly-identified GMM with an identity weighting matrix). Other parameters are identical to those in Athreya, Tam, and Young (2008) – these include the resource cost of default  $\Delta$ , the income processes faced by each type, the measure of each type, and the parameters of the retirement system  $(\theta, \Theta)$ .<sup>19</sup>

It is clear that our model is not capable of exactly matching the entire set of moments – for example, we underpredict default rates and discharge, generally underpredict debt-to-income ratios, and overpredict the measure of borrowers. The model actually places very tight links between some variables, restricting the minimization routine’s ability to independently vary them. For example, suppose we attempt to improve the model’s prediction for the measure of borrowers by increasing  $\beta$ . Holding all other parameters constant, we would reduce default rates and debt-to-income ratios for all types (and these variables are generally already too small). To counteract this effect, we need to move  $\lambda$  for each type and each state. Consider first increasing both  $\lambda_i^H$  and  $\lambda_i^L$  for one type  $i$ . While this change would increase the default rate – bankruptcy becomes less costly – it would via a supply side effect tend to reduce debt levels (see Athreya 2004). Suppose instead we increase  $\lambda_i^H$  and decrease  $\lambda_i^L$ ; this change has countervailing effects on both default rates and debt levels. For example, default rates could rise because it becomes cheaper for  $H$  types, but it also becomes more expensive for  $L$  types; thus, whether we can adjust the parameters to increase default depends on whether low-type or high-type responds more elastically. A similar tension exists for debt-to-income ratios – driving it up for one type tends to drive it down for the other. The minimization routine we used to calibrate the model resolved these tensions as well as possible, resulting in some good results – for example, we do a good job at generating discharge – and some poor ones (college types in our model default much less than in the data).

It is also important to note that the qualitative findings from our analysis do not depend on our specification of the stochastic process for  $\lambda$ ; harsh punishments continue to improve welfare in the case with (i) a single, constant  $\lambda$ , (ii) constant, but type-specific  $\lambda$ , and (iii) stochastic, but not type-specific default costs. Therefore, while our specification allows us to match the salient features of debt and default, it does not play a critical role in the welfare implications of default policy.<sup>20</sup>

We consider two environments – one environment with a calibrated value for  $\Delta$  and one with a cost  $\Delta$  sufficient to eliminate default on the equilibrium path. Table 2 contains the welfare gain obtained by extreme punishment – making it infeasible for any household to declare bankruptcy. Consistent with our previous work, we find that banning bankruptcy leads to a welfare improvement ex ante for every newborn (independent of type). College types benefit the most from the change, and their welfare gain is substantial (1.2 percent of lifetime consumption). To aid the discussion

<sup>18</sup>Similar regulations are present in the UK and the EU.

<sup>19</sup>Specifically, we set  $v = 0.35$ ,  $\Upsilon = 0.2$ ,  $\phi = 0.03$ ,  $\Delta = 0.03$ ,  $\varsigma = 0.95$ ,  $\sigma_{n,\epsilon}^2 = 0.033$ ,  $\sigma_{n,\nu}^2 = 0.04$ ,  $\sigma_{h,\epsilon}^2 = 0.025$ ,  $\sigma_{h,\nu}^2 = 0.021$ ,  $\sigma_{c,\epsilon}^2 = 0.016$ , and  $\sigma_{c,\nu}^2 = 0.014$ .

<sup>20</sup>If “stigma” is also a function of aggregate default rates (an agent cares less about default if everyone else is defaulting), then this invariance may break. We leave this for future work.

in subsequent sections where we alter preference parameters, we quickly summarize the reasons for the welfare gains here.

By eliminating bankruptcy, the loss of resources generated by the filing cost goes down. Since we do not impose an economy-wide resource constraint, these lost resources are not important. Instead, the welfare gain is driven by an improved allocation of consumption. Consider the following decomposition of the variance of consumption over the life-cycle:

$$V(\log(c)) = V(E[\log(c)|\text{age}]) + E[V(\log(c)|\text{age})].$$

We label the first term the “intertemporal” component of consumption smoothing; it represents how expected consumption differs across time periods. The second term is the “intra-temporal” component; it measures how much consumption varies across agents of a given age. Roughly speaking, how costly the first component is in terms of welfare depends on the elasticity of intertemporal substitution, because it measures the deterministic variance of consumption over time, whereas the welfare cost of the second part is governed by static risk aversion. In Figure 1 we see that having harsh penalties (the “No-Bankruptcy” (NBK) case) improves intertemporal smoothing (the curve gets flatter) because all lending becomes risk-free. Thus, as we noted in the introduction, the only debt limit that is relevant is the natural debt limit, which is very large in our model for newborn agents. Turning to the intra-temporal part, in Figure 2 we see that NBK improves this part as well, restating the analysis in Athreya, Tam, and Young (2009) that unsecured credit markets do not provide insurance. Here, bad shocks tend to trigger tightening of credit constraints, making consumption smoothing across states of nature more difficult. As a result, young agents are unable to respond effectively to bad income realizations when they can declare bankruptcy, causing their consumption to be highly volatile. Under NBK the natural debt limit is sufficient to protect them against adverse shocks; by middle age bankruptcy has ceased to be relevant and thus the two cases largely coincide.<sup>21</sup>

The differences in consumption across the BK and NBK cases are driven by changes in the pricing functions that agents face. In Figures 3-5, we show the pricing functions in the low punishment environment facing a young college agent across realizations of the persistent shock  $e$ . The initial flat segment is driven by  $\Delta$  and is increasing in the current realization of the persistent shock  $e$ . As debt increases, more realizations of  $e'$  would trigger default, causing  $q$  to decline until it reaches zero; looking across  $e$  values we see that higher  $e$  realizations permit more borrowing. Of course, higher  $e$  realizations in our model are typically associated with less, not more, borrowing, so these increased debt limits are not particularly valuable; instead, the tightening of credit limits when  $e$  is low generates substantial costs for poor agents. In contrast, under NBK pricing is flat out to the natural debt limit, which is very large, and does not vary substantially with  $e$ . Crucially, transitory shocks do not impact pricing; because  $\nu'$  cannot be predicted using  $\nu$ , the current transitory shock has no effect on the default decision tomorrow conditional on  $b$  ( $b$  is changed by the transitory shock, however).

The potential tradeoff between the two components of smoothing motivated the life-cycle analysis of Livshits, MacGee, and Tertilt (2007) and Athreya (2008), so why doesn't bankruptcy generate this tradeoff? As discussed in Athreya, Tam, and Young (2009), bankruptcy can either help or hinder intra-temporal smoothing, depending on which agent you ask. An agent facing an income process with low intertemporal variance but high intra-temporal variance – that is, tomorrow's expected income is close to current income but tomorrow's income has substantial risk – may benefit from bankruptcy; the intertemporal distortion is minimal while the potential to truncate the consumption distribution at the low end conveys significant benefits (even once pricing is taken into

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<sup>21</sup>The figures are drawn for the aggregate, since the results are the same for each type qualitatively. Figures decomposed by type are available from the authors upon request.

account). In contrast, an agent facing the opposite process – income that grows over time and is relatively safe – generally does not benefit; default is not used because pricing prevents it and the intertemporal distortion is substantial, leading to significant welfare losses. In our model, a young agent is of the second type, especially a college-educated one, while older households are members of the first type. From the perspective of a newborn, it is not surprising that mild penalties generate a net welfare loss.

Because we study an small open-economy model in which the risk-free rate is fixed, but also allow all pricing to be individualized, there are no “pecuniary” externalities; we can therefore legitimately calculate welfare gains and losses at different points over the life cycle.<sup>22</sup> Suppose we ask agents of a given age and type whether, conditional on their current state, they would be willing to eliminate the option to default.<sup>23</sup> Figure 6 displays the measure of each type, conditional on age, that would support retaining bankruptcy. First, a substantial portion of college types oppose elimination, but they are all middle-aged and have experienced a bad transitory shock that they would like to smooth away using default; the peak in opposition occurs earlier for high-school types and later for non-high-school types, with correspondingly fewer such households opposing overall. For the convenience of the reader, Table 3 presents the aggregate measures of each type that oppose eliminating bankruptcy (the column labeled “BK Regime”); they are small for each education group. Furthermore, as is clear from the figures, almost no newborns oppose eliminating the option. In this sense, the statement that eliminating bankruptcy is welfare improving for newborns almost holds even when made conditional on the initial shock realization.

The converse of the preceding exercise, whereby agents of different ages and permanent income levels are asked if they would prefer to *introduce* bankruptcy into a setting in which it is currently prohibited, is also interesting. The essence of this experiment is whether the ability to commit to not defaulting will create circumstances in which a significant number of agents subsequently would introduce default, in effect creating a constituency for bankruptcy options. As seen in Figure 7, a nontrivial fraction of agents would like to introduce bankruptcy. The intuition here is that the no-bankruptcy case allows significant borrowing at the risk-free rate. As a result, many households, especially the high-school and college-educated, borrow when young in anticipation of higher earnings. The relatively unlucky among them then find themselves indebted by middle age and thereby will benefit immediately from the discharge of debts. Moreover, by virtue of being middle-aged, these households place relatively low value on being able to access the cheap unsecured debt later in life that harsh punishments for default facilitate. This effect is especially strong for the college-educated, for whom purely intertemporal consumption smoothing motives dictate a strong effort to save for retirement beyond middle age. As a result, a substantial proportion of high-school and college-educated household groups would support the introduction of bankruptcy when they reached middle age. In contrast, those who have not completed high school support the introduction of bankruptcy only late in working-life, when the subsequent increase in borrowing costs is not long-lasting. However, as Table 3 shows (the column “NBK Regime”), the aggregate number of agents who vote in favor of introduction falls well short of majority status.

### 3.1.2 Separating Risk Aversion from Intertemporal Substitution

As discussed above, the two pieces of the variance decomposition have welfare costs that depend (mainly) on different aspects of preferences. Our benchmark case using CRRA expected utility restricted these two aspects of preferences to be reciprocals of each other. Here, we relax that

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<sup>22</sup>This calculation is similar to the one conducted in Zame (1993).

<sup>23</sup>The stationary distribution of wealth will be different, but since it plays no role in pricing we do not need to compute the transition to obtain welfare calculations.

requirement by using the Epstein-Zin preference structure, and consider two particular deviations. First, we make households more tolerant of intertemporal variance than in the expected utility benchmark by employing a high value for  $\rho$ , the elasticity of intertemporal substitution (EIS). Table 2 shows that in so doing, we reduce the costs of bankruptcy. Second, since the bankruptcy option may shrink the volatility of intratemporal consumption, at least for some ages, making intratemporal variance more costly may help us explain the presence of lax default penalties; this leads us to select a relatively high value for  $\sigma$ . It is important to note that this particular combination of insensitivity to the timing of consumption and sensitivity to the income state in which it occurs is the arrangement that gives lax penalties for default their best chance of improving *ex ante* welfare. It is also important to note that considering this case is not possible within the class of expected utility preferences. We consider the experiment in which we change  $\rho$  without recalibrating the entire model. This change generates two effects – an effect conditional on borrowing (which we call the price effect) and an effect caused by changes in the number of borrowers (the extensive effect).

To understand the extensive effect, it is helpful to first consider the extreme case of  $\rho = 1$ , making the household infinitely willing to move consumption deterministically through time. As  $\rho \rightarrow 1$ , the Bellman equation converges to the form

$$v(a, y, e, \nu, \lambda, j) = c_j + \beta \psi_{j,y} \left( \sum_{e', \nu', \lambda'} \pi_e(e'|e) \pi_\nu(\nu') \pi_\lambda(\lambda'|\lambda) V(b, y, e', \nu', \lambda', j+1) \right)^{\frac{1}{1-\sigma}}$$

Here, the household will either completely frontload or backload consumption, depending on the relationship between the discount factor and the interest rate. For the parameterization we use, the effective discount factor ( $\beta$  times the survival probability) lies between the risk-free saving and borrowing rates for almost every age, meaning that households are hand-to-mouth and, critically, do not value the default option at all *no matter how risk averse* they are. For some older households the effective discount factor is sufficiently low that they want to borrow and “frontload” their consumption; the option to default makes complete frontloading impossible and therefore reduces the welfare of these households – since they face no uncertainty default is either probability zero or one and pricing therefore eliminates it. Obviously such extreme consumption behavior is inconsistent with U.S. cross-sectional facts; in particular, the model with  $\rho = 1$  would miss very badly on the lifecycle pattern of consumption inequality, which in the data is substantially smaller than income inequality.

Returning to less extreme values, Figure 8 displays the pricing function across several different values of  $\rho$  and demonstrates the effect on loan prices. As  $\rho$  increases, the pricing function shifts downward – at any given level of debt an agent with a higher  $\rho$  is more willing to default. The intuition for this result is not straightforward. When  $\rho$  increases, the household is more willing to accept deviations in consumption across time; in particular, the household values mean consumption only when  $\rho = 1$ . If a household enters the current period with some debt there are two options: (i) borrow more if possible or (ii) default and void those obligations. Borrowing more is only feasible if there is a reasonable commitment to repay; since a bad shock would lead to low mean consumption bankruptcy becomes attractive since repayment lowers mean consumption. The cost of strong default incentives – namely the distortion of intertemporal smoothing – is relatively unimportant.

Consider next an experiment where  $\sigma$ , the risk aversion with respect to gambles over future utility, is increased. Again, turning first to the polar case, let  $\sigma \rightarrow \infty$ , so that the household becomes infinitely risk averse. In this case, the limiting household Bellman equation takes the form

$$v(a, y, e, \nu, \lambda, j) = \left\{ n_j \left( \frac{c_j}{n_j} \right)^\rho + \beta \psi_{j,y} \min_{e', \nu', \lambda'} \{ V(b, y, e', \nu', \lambda', j+1) \}^\rho \right\}^{\frac{1}{\rho}}.$$



When households are infinitely risk-averse they choose not to borrow, for the reasons outlined in Athreya, Tam, and Young (2009) – unsecured credit markets do not provide insurance and thus agents will be unwilling to pay the transaction cost to borrow. As a result, there is no welfare gain from eliminating bankruptcy – no household is in a position to default. Again, extreme preferences render the model grossly inconsistent with cross-sectional facts; here, consumption inequality would be essentially zero over all ages.

Returning again to more intermediate cases, we see that changes in risk-aversion generates two effects. The extensive margin effect is similar to increasing  $\rho$ , but for different reasons. When  $\sigma$  is large, households have a strong demand for precautionary savings; for  $\sigma = 5$ , for example, we see a clear decline in the measure of total borrowers, again making bankruptcy overall less damaging. The pricing effect is also similar; by increasing risk aversion, we make the household less willing to have consumption differ across states of the world tomorrow. Conditional on borrowing the pricing functions reveal a stronger desire to default – for any given  $b$ , the price of debt is decreasing in  $\sigma$  (see Figure 9). As above, there are only two options for a household with debt; since even a moderately bad outcome will cause a highly risk-averse agent to default, commitment is not possible, leaving default as the only option for smoothing consumption across states.<sup>24</sup> Combining these results into one statement, we see that no combination of  $(\rho, \sigma)$  leads to bankruptcy being a welfare-improving policy, although for extreme cases it will be nearly innocuous.

We see that welfare gain (for newborns) from eliminating bankruptcy (imposing the high  $\Delta$ ) declines with risk aversion and EIS in Table 3.  $\rho > 1 - \sigma$  – which is satisfied when either parameter increases – implies the household has a preference for early resolution of uncertainty; thus, bankruptcy appears to be least damaging when households prefer to resolve their risk early rather than late.

All of these results are obtained without recalibrating the model. To ensure that our findings are not particularly sensitive to this strategy, we also recalibrate the model for different values of  $\rho$  and  $\sigma$ , to the extent that this recalibration is possible; Table 1 contains the new parameter settings that best fit the targets under alternative settings. By doing so, we shut off the extensive margin (no change in the measure of borrowers); the welfare gain from bankruptcy elimination is then solely a function of whether it improves either intertemporal or intratemporal consumption allocations. When we recalibrate, we find that with high EIS all welfare gains from eliminating bankruptcy are substantially reduced, with both noncollege types now barely benefiting at all (see Table 4), while for high risk aversion the welfare gains increase slightly. As noted above, this welfare change is entirely due to the shifts in the pricing function that higher EIS and/or higher risk aversion engender. Thus, for no parameter combination that we consider do we observe welfare gains from retaining the bankruptcy option.

A summary of findings thus far is that harsh penalties significantly improve allocations for income risk and preference parameters that are empirically plausible for U.S. data, as well as for more extreme values of preference parameters with both the classes of expected utility and Epstein-Zin non-expected utility preferences. We turn now to the question of whether such policies continue to remain desirable under two further (and substantial) departures from the settings studied so far.

### 3.2 Are Harsh Penalties Ever Worse?

We begin this section by allowing for the underlying volatility of income to be driven by relatively more and less persistent income shocks. For this experiment, we hold the unconditional variance of labor income fixed and vary the relative contributions of the persistent component  $e$  and the

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<sup>24</sup>Our model satisfies the conditions noted in Chatterjee *et al.* (2007) that imply default occurs only if current debt cannot be rolled over: If  $d(\epsilon', \nu', \lambda') > 0$  for some  $\epsilon', \nu', \lambda'$  then there does not exist  $b$  such that  $a - q(b)b < 0$ .

transitory component  $\nu$ . We then ask whether a relaxation in the household’s understanding of the probabilistic structure of earnings risk can open the door for welfare-improving default. For this experiment, we allow for households to display ambiguity aversion in the sense of Klibanoff, Marinacci, and Mukerji (2009).<sup>25</sup>

### 3.2.1 The Roles of Persistent and Transitory Income Risk

It has long been known that self-insurance, and by extension, the benefits of insurance markets, hinges on the persistence of the risks facing households. As a general rule, the more persistent are shocks, the more difficult they are to deal with via the accumulation of assets in good times and decumulation and borrowing in bad times. In contrast, purely transitory income shocks can typically be smoothed effectively. In a pure life-cycle model, however, there are additional impediments to self-insurance: young households are born with no wealth and often face incentives to borrow arising from purely intertemporal considerations. In particular, those with relatively high levels of human capital, especially the college-educated, can expect age-earnings profiles with a significant upward slope into late middle-age. As a result, such households would like, even in the absence of any shocks to income, to borrow, often substantially, against their growing expected future income. In contrast, those households with low human capital face a far less income-rich future, and as a result borrow primarily to deal with transitory income risk.

In order to understand the role that the persistence of income risk plays in the welfare gains or losses arising from harsh punishments, we now evaluate the effects of changes in the persistent component of household income risk, for all three classes of households. However, in order to avoid conflating persistence and overall income volatility, we adjust the variance of transitory income volatility such that the overall variance of log labor income remains fixed throughout. Figure 10 and Tables 5 and 6 present the welfare and consumption smoothing implications of harsh punishments under varying income shock persistence. The first column of each table documents the fraction of total variance contributed by the persistent component.

Normatively, three findings are noteworthy. First, and perhaps most importantly, harsh penalties improve welfare irrespective of the nature of shocks accounting for observed income volatility. This result strengthens our findings thus far, and it further suggests that defaultable debt is simply unlikely to be useful to households. It is also a particularly important form of robustness, given both the general importance of persistence for the efficacy of self-insurance and borrowing and because estimates of income shock persistence vary dramatically (see Guvenen 2007, Hryshko 2008, or Guvenen and Smith 2009 for discussions of the debate between “RIP” and “HIP” and their impact on persistence estimates). Second, the effect of the contribution of persistent shocks to income volatility depends on the permanent income of households. In particular, when volatility is driven primarily by persistent shocks, the relatively well-educated benefit from the elimination of default substantially more than their less educated counterparts. Conversely, when most income variability is driven by large but transitory shocks, it is the relatively less-educated who benefit most from the elimination of the default option. Third, within each educational class, the welfare gains from harsh penalties decline monotonically as the relative contribution of the persistence of the shock grows; default on debt is least (most) useful when income volatility is driven primarily by shocks which are transitory (persistent). What is surprising, but in keeping with the main theme of our results, is that in no case is it true that lax penalties are more desirable, *ex ante*, than harsh ones. Moreover, even in the case where essentially all income risk is delivered in the form of persistent

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<sup>25</sup>There are connections between ambiguity aversion and the concept of Knightian uncertainty from Bewley (2002), although the latter concept does not permit preferences to be represented by a utility function and is therefore hard to analyze quantitatively.

shocks where credit markets are least useful in dealing with income risk, harsh penalties generate non-trivial welfare gains, at up to 1.24 percent of consumption for college-educated households (as seen in Figure 10).

In Figures 11 and 12, we display the measure of borrowers at each age and the conditional mean of debt among those who borrow for two levels of the importance of persistent income risk.<sup>26</sup> The fact that the gains from implementing harsh penalties rise for all agent-types with the importance of transitory shocks is a consequence of the increased usefulness of credit in dealing with transitory income risk. Conversely, when shocks are primarily persistent, a negative realization requires a more frequent borrowing, and often, more debt toward middle age, the combination of which is ultimately unable to stem the transfer of income risk to consumption volatility. In Tables 5 and 6, we see that irrespective of bankruptcy policy, persistence translates into higher consumption volatility, and that the presence of lax default penalties seen in Table 6 does little to stem the flow of income risk into consumption risk (echoing our previous result in Athreya, Tam, and Young 2009). In fact, by comparing Table 5 with Table 6, it is clear that for all the persistence levels we consider, total unconditional consumption volatility within each permanent-income group is lower under lax penalties than under harsh penalties. This result is of course central in explaining the uniformly positive welfare gains from moving to large default penalties, much more so than the elimination of the deadweight costs of bankruptcy.

We turn next to the relationship between shock persistence and equilibrium default rates, displayed in Figure 13. Default is “U-shaped,” with high default rates at both ends. To understand this shape, consider first the case where the labor income shocks are nearly all transitory (the left side of the graph). Here, agents can generally manage their risk effectively via saving and dissaving, but they choose to augment the self-insurance mechanism with default at higher rates than they do in the benchmark setting. The reason they do so is that risk-based pricing is not effective here, because there is no useful information contained in the current labor income of the borrower that would identify future bad risks. As a result, agents can default with impunity. In contrast, the case where labor income is driven entirely by the persistent component (the right side of the graph), high default is the result of agents being generally unable to smooth consumption; persistent shocks are hard to smooth using assets alone (and if permanent are in fact impossible). As a result, despite the pricing effects borrowers will use default relatively often. The middle parts of the graph, where default is lowest, balance these two effects.

Intuitively, with harsh default penalties, borrowers realize that debt must be repaid, and under high persistence, heavy borrowing in response to a negative shock makes low future consumption relatively likely. Nonetheless, credit markets are willing to lend to such households at the risk-free rate (adjusted for any transactions costs of intermediation), making total debt rise. Under lax penalties, borrowing today to deal with persistent income risk does not expose the borrower to severe consumption risk in the long term as default offers an “escape valve,” but it does expose lenders to severe credit risk in the near term. Creditors then price debt accordingly; as seen in Figure 14, when shocks are primarily persistent, as the current shock deteriorates so do the terms at which borrowers can access credit. Moreover, under a bad current realization of income, households facing persistent risk see a disproportionate decline in the price of any debt they may issue, while the reverse occurs in the event of a good current realization of income; the pricing functions essentially “switch places.” Yet, despite the increased sensitivity of loan pricing to the borrower’s current income state under relatively high persistence, the welfare gains from implementing harsh penalties, though still positive, fall. This result obtains because of the reduction in the ability of self-

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<sup>26</sup>From the perspective of a newborn, the measure of borrowers at a given age equals the probability of the newborn borrowing at that age.

insurance, inclusive of borrowing, to prevent income fluctuations from affecting consumption. To sum up, income risk is quantitatively relevant in governing the gains from the imposition of harsh penalties appears, but irrelevant for altering the qualitative welfare properties.

### 3.2.2 Ambiguity Aversion

We turn next to the question of whether harsh penalties can improve outcomes when households are not perfectly certain about the probabilistic structure of income risk. Following Klibanoff, Marinacci, and Mukerji (2009), under ambiguity aversion preferences, a household of age  $j$  solves the dynamic programming problem

$$\begin{aligned} v(a, y, e, \nu, \lambda, j) &= \max_{b, d(e', \nu', \lambda') \in \{0, 1\}} \left\{ \frac{n_j}{1-\sigma} \left( \frac{c_j}{n_j} \right)^{1-\sigma} + \beta \psi_{j,y} \sum_{e', \nu'} p(e', \nu' | e, \nu) \Phi(EU) \right\} \\ EU &= \sum_{e', \nu', \lambda'} \pi_e(e' | e) \pi_\nu(\nu') \pi_\lambda(\lambda' | \lambda) V(b, y, e', \nu', \lambda', j+1) \end{aligned} \quad (10)$$

where

$$\Phi(x) = \begin{cases} \frac{1 - \exp(-\eta x)}{1 - \exp(-\eta)} & \text{if } \eta > 0 \\ x & \text{if } \eta = 0 \end{cases}$$

determines preferences over ambiguity.  $\eta \geq 0$  controls the attitude toward ambiguity; as  $\eta$  increases, the household becomes more averse to ambiguous stochastic processes. The restrictions on the choices of  $p(e', \nu' | e, \nu)$  are that they must sum to 1 for each  $(e, \nu)$  and every element must lie in some set  $\mathcal{P} \subset [0, 1]$ ; we nest the standard model by setting the  $\mathcal{P}$  set to be an arbitrarily small interval around the objective probabilities.<sup>27</sup> Because we are interested in these preferences only to the extent that they may provide an environment in which lax punishments are welfare-enhancing, we will deliberately take the most extreme case of  $\eta = \infty$ , yielding the max-min specification from Epstein and Schneider (2003):

$$\begin{aligned} v(a, y, e, \nu, \lambda, j) &= \max_{b, d(e', \nu', \lambda') \in \{0, 1\}} \left\{ \frac{n_j}{1-\sigma} \left( \frac{c_j}{n_j} \right)^{1-\sigma} + \beta \psi_{j,y} \min_{p(e', \nu' | e, \nu)} EU \right\} \\ EU &= \sum_{e', \nu', \lambda'} p(e', \nu' | e, \nu) \pi_\lambda(\lambda' | \lambda) V(b, y, e', \nu', \lambda', j+1) \\ V(b, y, e', \nu', \lambda', j+1) &= (1 - d(e', \nu', \lambda')) v(b, y, e', \nu', \lambda', j+1) + \\ &\quad d(e', \nu', \lambda') v^D(0, y, e', \nu', \lambda', j+1) \end{aligned} \quad (11)$$

where

$$\begin{aligned} v^D(0, y, e, \nu, \lambda, j+1) &= \left\{ \frac{n_j}{1-\sigma} \left( \lambda \frac{c_j}{n_j} \right)^{1-\sigma} + \beta \psi_{j,y} \min_{p(e', \nu' | e, \nu)} EU \right\} \\ EU &= \sum_{e', \nu', \lambda'} p(e', \nu' | e, \nu) \pi_\lambda(\lambda' | \lambda) v(0, y, e', \nu', \lambda', j+1) \end{aligned} \quad (12)$$

is the value of default.

The min operator that appears in front of the summation reflects the agent's aversion to uncertainty – as shown by Epstein and Schneider (2003), a household who is uncertainty-averse (or

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<sup>27</sup>We do not require that the household assume that the probabilities of the independent events are independent in every distribution that is considered. That is, the household may be concerned that the independence property is misspecified and therefore select a worst-case distribution in which the events are correlated.

ambiguity-averse or concerned with model misspecification) chooses the subjective distribution of future events that is least favorable and then makes their decisions based on that subjective distribution.<sup>28</sup> We use  $\pi$  to denote objective probabilities and  $p$  to denote subjective ones; note that households are assumed to face uncertainty only about the distribution of income shocks. In the extreme case the preferences of the household with respect to ambiguity aversion determine the size of this set (in effect, conflating the amount of ambiguity or uncertainty and the agent’s aversion to it); as an example, a typical  $p_{ij}$  element lies in the interval  $\left[ \mathbf{p}_1^{ij}, \mathbf{p}_2^{ij} \right] \subset [0, 1]$  where a larger set implies more aversion to uncertainty.<sup>29</sup>

Standard ambiguity aversion models imply that households will learn over time and reject stochastic processes that are inconsistent with observed data (for example, a household who initially entertains the possibility of permanently receiving the worst-possible income level forever will dismiss this process as soon as one non-worst realization occurs). We will focus our attention on a special case of extreme ambiguity aversion in which this learning does not occur; if lax punishments are not optimal in this environment they are unlikely to be optimal when households face less uncertainty.

Given the qualifications and considerations discussed above, we now evaluate harsh default penalties in the case where the agent is infinitely averse to ambiguity, implying that probabilities are chosen from the entire interval  $[0, 1]$  (a less severe aversion to ambiguity would imply probabilities chosen from a restricted interval surrounding the objective probability). The intuition is that such a case offers the possibility, discussed at the outset, that lax penalties for default might actually encourage the use of credit for consumption in a setting where the agent’s aversion to ambiguity would otherwise preclude becoming indebted. And in fact, we *do* find that this case delivers bankruptcy as welfare-improving for some agents. However, this finding is very limited: Benchmark default penalties improve welfare for only the college type and the welfare gain is tiny (but not an artifact of numerical error). As a result, unconditional *ex ante* welfare is negative since college types are not a large enough group to overcome the losses to the remainder of the population. It is interesting to see, however, that the welfare gains from severe punishments are now reversed – the largest gains are experienced by the most educated. Part of the intuition for this result is that it is the best educated who face the steepest mean age-earnings profiles. Therefore, these agents would have the strongest purely intertemporal motives to borrow, absent any ambiguity. Lenient default penalties mitigate the effect of ambiguity and allow for states in which a temporarily unlucky college-educated agent would find borrowing desirable.

Pricing is presented in Figures 15 and 16. Notice that for the low realization of  $e$ , the pricing function under ambiguity aversion is everywhere below the baseline expected utility case, but for the higher realization they cross; for large enough values of debt ambiguity-averse agents actually pose *less* of a default risk because they are extremely concerned about the bad events that might happen in the future (low income along with the costs of defaulting).

In this model, the worst-case outcome is easy to calculate – it is the lowest  $(e, \nu)$  combination. Infinitely ambiguity-averse agents place probability one on this event happening tomorrow, causing them to save in order to increase consumption in the future. We can see that both the number of borrowers and the amount borrowed declines quite a bit. As a result, limited borrowing reduces the damaging effects of bankruptcy. Relative to the benchmark, households in the ambiguity aversion environment can borrow less when they are unlucky and more when they are lucky. Of course, this is precisely what they do not want to do, and is another manifestation of the fact that unsecured

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<sup>28</sup>Applications of ambiguity aversion using this specification can be found in Alonso (2007), Alonso and Prado (2008), and Routledge and Zin (2009).

<sup>29</sup>Hansen and Sargent (2007) provide an interpretation in terms of detection probabilities.

credit markets do not function as insurance markets – they reward agents who do not want to borrow with the largest credit limits.

Is such extreme ambiguity aversion “reasonable?” It seems highly unlikely that households entertain a stochastic process in which they receive the worst possible outcome forever with probability one as reasonable, at least not for long – after all, they need only observe the fact that their income is occasionally higher than the lower bound to discard this process empirically. As we noted above, we could introduce this learning into the model – since the households are simply learning about an exogenous process, it can be done “offline” – but it is computationally quite burdensome to condition the set of permissive stochastic processes on the history of observations.<sup>30</sup> If we consider more reasonable limits – 10 percent above or below the objective value – we find that bankruptcy is welfare-reducing for all education levels. Thus, while ambiguity aversion provides a theoretical foundation for bankruptcy options, it does not provide an empirically tenable one.

### 3.3 Loan Guarantees as an Alternative to Harsh Penalties

The preceding results have shown that with the class of models considered here, it is very difficult to rationalize observed debt default policy. A key feature of the model is that default risk is met by “risk-based” pricing, which in turn severely limits the ability of those who pose significant default to issue debt. In particular, lax default policy and persistent income shocks meant that negative shocks led to an immediate, and large, increase in the cost of borrowing.<sup>31</sup> However, recent credit policy has employed loan guarantee programs in a variety of circumstances. Loan guarantees hold the promise of allowing borrowers to retain the risk-sharing features of default without forcing them to face the full effect of market prices that change with their individual state. As a result, such programs may help household welfare by simultaneously combining the state-contingency of defaultable debt with the spreading of default costs across households. In short, under a full loan guarantee, borrowers with different default risks will face identical borrowing costs. Nonetheless, as mentioned at the outset, loan guarantees have never been used to improve access to unsecured consumption credit, but rather have been reserved by investment financing for human capital, residential real estate, and more general forms of physical capital.<sup>32</sup>

The structure for loan guarantees we employ mirrors that of loan guarantee programs employed by the U.S. Small Business Administration (SBA). In particular, the SBA commits to compensate lenders partially for losses incurred from default, while placing requirements on loans governing their riskiness. Therefore, in the model, a loan guarantee program will be completely described by two parameters: (i) a “coverage” parameter, which is a fraction  $\theta \in [0, 1]$ , and (ii) a “maximal riskiness” parameter  $q^* \in [0, 1]$ . The interpretation of these parameter is that the government will insure  $\theta$  percent of any loan whose riskiness does not exceed  $q^*$ , where  $q^*$  is the loan price that would obtain the *absence* of any loan guarantee scheme. For each  $q^*$  there exists a limit  $b^*$  that corresponds to the debt level that generates riskiness equal to  $q^*$  under the no-transfer pricing system. The resulting pricing function under a loan guarantee scheme therefore contains an extra additive term relative to equation 4 indicating the compensation received by lenders in the event

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<sup>30</sup>Since this learning is not Bayesian, it can be quite difficult to write recursively. Campanale (2008) investigates non-Bayesian learning in a two-state model where it is tractable.

<sup>31</sup>Further discussion of the effect of risk-based pricing is given in Athreya, Tam, Young (2009) and Tam (2009).

<sup>32</sup>These programs are very wide-ranging. In addition to the well-known programs for home loans, small business, and higher education, public loan guarantee programs exist for “clean energy projects,” fisheries, auto manufacturers, and even “double-hulled” oil tankers. One example is here: <http://www.lgprogram.energy.gov/features.html>.

of borrower default:

$$q(b, I) = \frac{(1 - \hat{\pi}(b)) \psi_j}{1 + r + \phi} + \frac{\hat{\pi}(b)}{1 + r + \phi} \frac{\theta \max\{0, b - b^*\}}{b - b^*}. \quad (13)$$

The revenue needed to finance loan guarantees is assumed to be obtained via proportional labor income taxation on all households. Note that the measure of households who pay for this program is large relative to the number who collect. In particular, all older households – few of whom will borrow – will pay taxes to pay for loan defaults by the relatively small set of young and unlucky borrowers.

The most obvious, and somewhat surprising, conclusion is that loan guarantees do not matter for allocations. Tables 7 and 8 show that borrowing and consumption smoothing are essentially unaffected by the imposition of these guarantee schemes. The immediate implication of these findings is that punishments and loan guarantees are not likely to be substitutable as tools to direct the flow of credit. Why don't loan guarantees matter for debt or consumption smoothing? The answer here is that loan guarantee schemes do not fundamentally alter the *shape* of the equilibrium loan pricing function faced by agents. Figure 17 shows how the introduction of the loan guarantee alters the pricing function for a selected cross-section of young agents. There are three pairs of loan pricing functions, where each pair plots bond pricing with and without loan guarantees for a given current realization of the persistent component of income risk. Naturally, as the current realization improves, the pricing improves from the borrower's perspective across both a regime with loan guarantees and one without. With respect to the effect of the guarantee, the salient aspect of the figure is that loan pricing still displays a “cliff” as borrowing exceeds a certain level. The point at which this cliff occurs is not far from where it occurs in the benchmark model (the dashed line). At this cliff, the marginal benefit from additional debt issuance falls to zero, while the expected cost in terms of default costs rises. In equilibrium, therefore, agents will not issue debt beyond the point where the fall in loan prices occurs. Of course, the loan guarantee does extend the range at which the agent may access credit at any given price, but not enough to change allocations.

Figure 18 examines how the pricing of debt is affected by  $\theta$ : For three fairly different levels of  $\theta$  loan pricing is not significantly altered (the choice of  $e = 8$  is merely for illustrative purposes, as the same results hold for other values). For all values considered, the effects are small –  $\theta > 0$  leads to only small increases in interest rates faced by borrowers. Thus, loan guarantee programs appear unlikely to meaningfully improve credit access, even when fairly generous from the borrower's perspective.

With respect to the riskiness of the loans, loan guarantee programs have the property that they reduce the riskiness of loans of size less than  $b^*$  but do not alter the riskiness of other loans directly; these loans change in riskiness only via indirect effects on the value function. Note that non-high-school types face hard credit limits under the system without loan guarantees, and thus do not benefit much from guarantees – their loans are all risk-free on the equilibrium path. Of course, it is in principle possible that substantially more generous guarantees than the ones reported in the tables thus far might affect outcomes more nontrivially. This turns out not to be the case: We find that allocations remain similar to the benchmark economy ( $\theta = 0$ ) for a wide variety of values for the fraction of the loan that is guaranteed. In particular, changing  $\theta$  does not deliver large changes in either extensive or intensive margins of borrowing, but rather converts some marginal borrowers into defaulters. In terms of consumption smoothing Tables 7 and 8 show that the effects of loan guarantees are negligible.

Figure 19 presents the identity of defaulters in the model with loan guarantees. Each “panel” of the figure contains the range of  $e$  values, with panels being defined by a value for  $\nu$ . As is

easily seen, the measure of agents who default for any given income state is largely the same when  $\theta = 0$  as when  $\theta = 0.25$  (and, though not shown for ease of presentation, when  $\theta = 0.5$ ). The key information presented by the figure is that defaulters are generally not the very unlucky (because such agents cannot access debt) nor the lucky (they are saving, not borrowing), but rather the “middle class.” This feature of default precludes loan guarantees from operating effectively as insurance. In other words, obtaining the transfer from default requires one to borrow, which is only possible if prospects for repayment are sufficiently good. As a result, households whose future income expectations are sufficiently low will not qualify for the payment, limiting the program’s ability to subsidize the truly unlucky.

The inability of loan guarantees to substantially change allocations also suggests that their impact on *ex ante* welfare will be small. Indeed, we find that from an *ex ante* perspective loan guarantees are always welfare-reducing (see Table 9). For example, the *ex ante* welfare cost of a program with  $\theta = 0.25$  and  $q^* = 0.2$  is 0.049 percent of lifetime consumption. This welfare loss is increasing in  $\theta$  – it more than doubles when  $\theta = 0.5$  – and decreasing (weakly) in  $q$ . From a welfare perspective, the welfare losses from loan guarantees arise from the taxes needed to finance them, as well as the incurred *ex post* resource costs of default. As seen in Table 10, as we vary both the generosity of the guarantee ( $\theta$ ) and the upper bound on default risk allowed under the loan guarantee program ( $q^*$ ), we see systematically higher taxes. Taxes themselves are small, but not meaningless; when taxes are ignored, for the case where  $\theta = 0.25$ ,  $q^* = 0.2$ , loan guarantees generate a minor welfare gain of 0.01 percent.

While we reported only the consequences of a few particular settings for  $(\theta, q^*)$ , we have also conducted a global search over all admissible combinations. We find that  $\theta = 0$  is globally optimal, in which case the value of  $q^*$  is irrelevant.

To further isolate the role of increased taxes in generating the negative welfare consequences, we have studied cases in which we do not impose the government budget constraint. For instance, in the extreme case where all loans are fully guaranteed ( $\theta = 1$ ,  $q^* = 1 - r - \phi$ ), welfare gains are unboundedly large. The unbounded welfare gain is a trivial consequence of the fact that in this case, all agents borrow  $b = -\infty$  and default in every period, leading to the government effectively obtaining the goods needed for the transfer program from abroad with no intention of repayment. This policy is clearly not feasible in practice. Nonetheless, it does demonstrate that loan guarantee programs raise the distinct possibility of borrowing solely to increase current consumption. However, this is likely to be a more general problem with loan guarantee programs in which funds can be used for consumption rather than investment. To avoid attempts by agents to simply increase consumption at little personal cost, the coverage rate  $\theta$  must stay well below unity; at lower levels, the implications for pricing will inherently remain similar to that which obtains without loan guarantees.

The taxes required to support widespread borrowing and default will lower welfare because the typical defaulter is not extremely poor. In other words, loan guarantee programs require taxes paid primarily by the large subset of agents who are non-defaulters to fund transfers to a small set of defaulters. In particular, the tax falls on both the poor who cannot borrow much on unsecured credit markets even under fairly generous loan guarantee schemes (and hence do not value the option to default), and also on the relatively well off. The transfer, by comparison, goes to the small subset of the “middle class” who default. The loss to the former is large, while the gain to the latter from the transfer is not large because the marginal utility of consumption for defaulting agents is not, in equilibrium, particularly big. Our findings therefore shed some light on why societies have thus far avoided loan guarantees for general consumption loans.<sup>33</sup>

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<sup>33</sup>An interesting topic for future research is whether loan guarantees can be welfare-improving when funded by



It is instructive to note that the proportional labor tax imposed here is not necessarily welfare-reducing. In a standard incomplete markets model (Bewley 1977), labor income taxation reduces the amount of uncertainty facing agents. When coupled with lump-sum uniform transfers, in the absence of labor supply distortions, a 100 percent tax rate is efficient. With such a program in place, all idiosyncratic risk is removed. Similar logic applies to a world like Kehoe and Levine (1993), where contingent claims exist but are limited by enforcement frictions. As noted above, the transfers generated by our loan guarantee program differ significantly from lump-sum uniform transfers, because only a small subset receive positive transfers. In addition, there is a moral hazard problem associated with the program – namely, that qualification for the transfer is influenced by the agents through the default decision. Thus, it is not surprising that transfers of this sort fail to improve welfare.

## 4 Concluding Remarks

We have studied two prevalent policy prescriptions aimed at channeling unsecured credit to households who lack collateral: legally-sanctioned penalties for debt default and government loan guarantee programs. In the first part of our paper, we evaluated the efficacy of punishments for default in improving credit access and welfare in a large range of settings in which risk aversion, intertemporal smoothing motives, income risk, and uncertainty over income risk itself were all varied. The second part of our paper evaluated the potential benefits of public guarantees on unsecured consumption loans as an alternative to harsh punishments for default. Loan guarantees preserve the state-contingency created by the default option without exposing the borrower to the full pricing-related consequences of default risk, but must be financed by taxes.

Our findings strongly suggest that within the broad class of models used thus far to develop quantitative theory for unsecured consumer credit and default, *neither* lax penalties nor loan guarantees are easily justified on the basis of *ex ante* welfare of new entrants to the credit market. Our findings also suggest that “expense” shocks or catastrophic movements in net worth are essential to the view of bankruptcy as a welfare-improving social institution. Prior work (especially Livshits, MacGee, and Tertilt 2007 and Chatterjee *et al.* 2007) has shown such shocks to be sufficient for welfare gains from penalties low enough to generate equilibrium bankruptcy. Our finding that, absent catastrophes, lax penalties harm welfare in a very wide set of circumstances, suggests that catastrophic risk may actually be *necessary* for justifying personal bankruptcy law as we currently see it in the U.S..

Even though our results are unambiguous from the perspective of *ex ante* welfare, we also show that there are *ex post* beneficiaries from lax punishments; specifically, we show that banning bankruptcy *ex ante* can lead to a measure of agents *ex post* who would vote to permit default. Our calibrated model predicts that these agents do not constitute a majority, though. This result deserves further consideration since it may help explain why lax punishments are becoming more prevalent over time. Our model is not suited for a political economy investigation of default policy, so we leave any such investigation for future work.

The policy implications of our findings may have some relevance in light of recent U.S. history. One obvious interpretation of U.S. credit policy in the wake of the financial crises that began in 2007 is that of an *ex post* loan guarantee scheme: Commercial banks have received large transfers to bolster balance sheets that deteriorated precisely because of high default rates. Our analysis suggests that if these policy actions were anticipated by lenders, serious misallocation of credit may

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alternative taxes. Since capital income taxation is often welfare-improving in incomplete market models, it may be interesting to examine what role it can have in funding welfare-improving loan guarantees.

have ensued *ex ante*.

With respect to future work, in light of the findings of this paper and the larger quantitative theory of consumer default, three directions seem particularly useful. First, even from an *ex ante* perspective, closing the door on lax penalties and loan guarantees may be premature. A more “normative” approach, which asks if observed default procedures can arise an optimal arrangement under plausible frictions, may yield different conclusions. One interesting example of the latter approach is the theoretical work of Grochulski (2009), where bankruptcy is shown to be one method for decentralizing a particular constrained Pareto optimum for a setting in which private information limits positions in contingent claims in both the positive and negative directions (unlike limited commitment models where limits to trade are only on one side, as shown in Alvarez and Jermann 2000). Quantifying such normative models may lead to better understanding of policy choices in this area (such as why Europe has chosen harsh bankruptcy and generous social insurance and the U.S. has chosen the opposite).

Second, with respect to the experiments we studied, we were led to allow for two specific preference extensions beyond constant-relative-risk-aversion expected utility in order to accurately assess the particular tradeoffs created by penalties for default, specifically Epstein-Zin preferences and ambiguity aversion. While we emphatically did not attempt to turn the paper into a survey of any larger variety of non-expected utility preferences, some further extensions seem potentially important: disappointment aversion (Gul 1991 or Routledge and Zin 2008), deviations from geometric discounting (Laibson 1997), habit formation (Constantinides 1990), and loss aversion (Barberis, Huang, and Santos 2001). Why these preferences specifically? In each case, the more general preference structure breaks the link between risk aversion and intertemporal substitution (and generally make risk aversion state-dependent), and some (such as loss aversion) also directly increase the incentive to take risks; there is also extensive empirical work supporting many of them. Nakajima (2008) investigates whether the temptation preferences of Gul and Pesendorfer (2001) alter the consequences of bankruptcy reform, a paper very much in line with our suggestions here.<sup>34</sup>

Lastly, to the extent that uninsured, catastrophically large, and “involuntary” expenditures are indeed a feature of the data, a natural question is whether consumer bankruptcy is the best way to deal with such events. Given the nature of resource transfers created by bankruptcy and the constraints that it imposes on the young, who disproportionately account for *both* the income-poor and uninsured, this statement seems unlikely. Future work on creating better alternatives for households facing catastrophic risk, such as a direct insurance scheme, therefore seems valuable – both for its own sake and for the benefits it may create by limiting the extent to which active creditors are forced to function as insurance providers; for example, hospital emergency rooms are required to treat patients who cannot pay at present, in effect making the hospital a financial intermediary (which is likely to be inefficient).

In all the models we study, the objective function (the right-hand-side of the Bellman equation) is not globally concave, since the discrete nature of the bankruptcy decision introduces convex segments around the point where the default option is exercised (we find that, as in Chatterjee *et al.* 2007, the default decision encompasses an interval and in our case it extends to  $b = -\infty$  as  $\Delta$  is smaller than even the worst income realization). The nonconcavity poses a problem for local optimization routines, so we approach it using a global strategy. We use linear splines to extend the value function to the real line and a golden section search to find the optimum, with some adjustments to guarantee that we bracket the global solution rather than the local one. It is straightforward to detect whether we have converged to the local maximum at any point in the state space, as the resulting price function will typically have an upward jump.

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<sup>34</sup>Nakajima (2008) predates our work, so he owes us no thanks for suggesting a paper topic.

For the ambiguity aversion case we have a saddlepoint problem to solve. By the saddlepoint theorem we can do the maximization and minimization in any order; the minimization (conditional on  $b$  and  $d$ ) is a linear program that we solve using a standard simplex method conditional on some  $b$  (as in Routledge and Zin 2009). We then nest this minimization within our golden section search, again with adjustments to deal with the presence of the local maximum. For our model, this linear program turns out to be extremely simple to solve – the household puts as much weight as allowed on the worst possible outcome, then as much weight as allowed on the next worst, and so on.

To impose boundedness on the realizations of income, we approximate both  $e$  and  $\nu$  by Markov chains using the approach in Flodén (2008). Having income be bounded above is convenient since it implies that there always exists a cost of default  $\Delta$  such that bankruptcy is completely eliminated because it becomes infeasible (see below). Quite naturally, bankruptcy is also likely not to occur when  $\Delta$  is high enough even if filing is feasible for some types; in general, households with high income are not interested in the default option in our model.<sup>35</sup>

Figure 20 shows a typical objective function for a household in our benchmark case (expected utility with  $\sigma = \rho^{-1} = 2$ ). The objective function has three distinct segments. The first segment is at the far right, where the values for both the low and high cost types coincide. In this region, default is suboptimal because borrowing either does not or barely exceeds  $\Delta$ . The second segment is at the other end, where  $q(b) = 0$ ; although impossible to see in the picture, the low cost default experiences slightly more utility in this region since default is less painful. The action is all in the middle segment. For this particular individual, the high cost type ( $\lambda_L$ ) borrows significantly more than the low cost type; this extra borrowing reflects primarily the pricing function (as seen in the lower panel) and not any particular desire to borrow. High cost types have more implicit collateral and are less likely to default at any given debt level, so they face lower interest rates. As a result, high type borrowers today who become low type borrowers tomorrow are a main source of default in our model – they both have debts and are not particularly averse to disposing of those debts through the legal system. Since type is persistent, low type borrowers today will not generally make the same choice – the supply side of their credit market will contract.

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<sup>35</sup>Households with high income realizations do not want to pay the stigma cost (which is proportionally higher for them) even if they are currently carrying a large amount of debt (which is very rare due to persistence). Thus, our model does not predict any "strategic" default.

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**Table 1**  
Calibration

Case	$\rho = -1, \sigma = 2$		$\rho = -0.5, \sigma = 2$		$\rho = -1, \sigma = 5$	
Parameter, Target	Parameter	Outcome	Parameter	Outcome	Parameter	Outcome
$\lambda_{nhs}^h, \pi_{nhs} = 1.03\%$	0.8972	0.31%	0.8668	1.24%	0.9376	0.51%
$\lambda_{nhs}^l, E(\frac{b}{y} b < 0)_{nhs} = 0.1552$	0.7624	0.2071	0.6929	0.2104	0.7538	0.1561
$\lambda_{hs}^h, \pi_{hs} = 1.11\%$	0.8832	0.97%	0.8064	1.29%	0.8872	1.31%
$\lambda_{hs}^l, E(\frac{b}{y} b < 0)_{hs} = 0.5801$	0.7135	0.1835	0.6933	0.1825	0.6236	0.2553
$\lambda_{coll}^h, \pi_{coll} = 0.57\%$	0.7067	0.63%	0.7136	0.79%	0.7055	0.76%
$\lambda_{coll}^l, E(\frac{b}{y} b < 0)_{coll} = 0.7251$	0.5698	0.1504	0.6352	0.1506	0.4205	0.2194
$\beta, \Pr(b < 0) = 12.5\%$	0.9765	17.5%	0.9895	13.3%	0.9532	12.5%
$\rho_\lambda, \frac{E(b d=1)}{E(y d=1)} = 0.56$	0.8597	0.3986	0.6655	0.4073	0.7658	0.4630



**Table 2**  
Welfare Gains (w/o Recalibration)

$\sigma = 2$ & $EIS = 0.5$	Coll	HS	NHS
$BK \rightarrow NBK$	1.21%	0.54%	0.52%
$\sigma = 2$ & <b>EIS = 0.67</b>	Coll	HS	NHS
$BK \rightarrow NBK$	0.58%	0.21%	0.13%
$\sigma = 5$ & $EIS = 0.5$	Coll	HS	NHS
$BK \rightarrow NBK$	0.47%	0.16%	0.13%

**Table 3**

Measure of Agents in Favor of Bankruptcy

Education	BK Regime	NBK Regime
Coll	6.45%	4.09%
HS	4.05%	3.26%
NHS	0.16%	0.24%
Total	4.05%	2.98%

**Table 4**  
Welfare Gains (w/ Recalibration)

$\sigma = 2$ & $EIS = 0.5$	Coll	HS	NHS
$BK \rightarrow NBK$	1.21%	0.54%	0.52%
$\sigma = 2$ & <b>EIS = 0.67</b>	Coll	HS	NHS
$BK \rightarrow NBK$	0.28%	0.05%	0.04%
$\sigma = 5$ & $EIS = 0.5$	Coll	HS	NHS
$BK \rightarrow NBK$	1.28%	0.57%	0.56%

**Table 5**  
Consumption Smoothing (BK)

	Intra			Inter			Total		
	Coll	HS	NHS	Coll	HS	NHS	Coll	HS	NHS
1.0%	0.0306	0.0462	0.0575	0.0359	0.0364	0.0386	0.0665	0.0826	0.0961
10.0%	0.0377	0.0561	0.0872	0.0343	0.0367	0.0357	0.0720	0.0938	0.1229
20.0%	0.0459	0.0807	0.1092	0.0336	0.0347	0.0325	0.0795	0.1154	0.1417
30.0%	0.0538	0.0884	0.1367	0.0327	0.0327	0.0297	0.0865	0.1211	0.1664
40.0%	0.0619	0.1013	0.1472	0.0316	0.0301	0.0280	0.0925	0.1314	0.1752
50.0%	0.0700	0.1146	0.1613	0.0305	0.0284	0.0263	0.1005	0.1430	0.1876
60.0%	0.0779	0.1280	0.1797	0.0294	0.0264	0.0241	0.1065	0.1544	0.2038
70.0%	0.0859	0.1413	0.1992	0.0283	0.0247	0.0224	0.1141	0.1660	0.2216
80.0%	0.0946	0.1543	0.2182	0.0272	0.0231	0.0211	0.1218	0.1774	0.2393
90.0%	0.1053	0.1681	0.2368	0.0258	0.0212	0.0199	0.1311	0.1893	0.2567
99.0%	0.1248	0.1863	0.2566	0.0235	0.0187	0.0180	0.1483	0.2050	0.2680

**Table 6**  
Consumption Smoothing (NBK)

	Intra			Inter			Total		
	Coll	HS	NHS	Coll	HS	NHS	Coll	HS	NHS
1.0%	0.0196	0.0307	0.0474	0.0318	0.0314	0.0120	0.0514	0.0621	0.0594
10.0%	0.0271	0.0397	0.0577	0.0315	0.0298	0.0124	0.0586	0.0695	0.0801
20.0%	0.0360	0.0541	0.0771	0.0311	0.0290	0.0131	0.0671	0.0831	0.0902
30.0%	0.0444	0.0683	0.0971	0.0306	0.0284	0.0137	0.0750	0.0967	0.1108
40.0%	0.0524	0.0820	0.1173	0.0300	0.0277	0.0144	0.0824	0.1097	0.1317
50.0%	0.0600	0.0951	0.1364	0.0295	0.0271	0.0151	0.0895	0.1222	0.1515
60.0%	0.0673	0.1076	0.1550	0.0291	0.0267	0.0158	0.0964	0.1343	0.1708
70.0%	0.0743	0.1197	0.1729	0.0288	0.0262	0.0164	0.1031	0.1495	0.1893
80.0%	0.0811	0.1314	0.1903	0.0285	0.0258	0.0171	0.1096	0.1627	0.2075
90.0%	0.0878	0.1428	0.2072	0.0282	0.0255	0.0178	0.1160	0.1638	0.2250
99.0%	0.0935	0.1528	0.2218	0.0280	0.0253	0.0182	0.1215	0.1781	0.2400

**Table 7**  
Consumption Smoothing

	Benchmark			$\theta = 0.25, q^* = 0.10$			$\theta = 0.25, q^* = 0.20$		
	Coll	HS	NHS	Coll	HS	NHS	Coll	HS	NHS
Intra	0.1087	0.1728	0.2363	0.1089	0.1729	0.2364	0.1093	0.1729	0.2365
Inter	0.0254	0.0206	0.0200	0.0253	0.0205	0.0200	0.0253	0.0205	0.0200
Total	0.1341	0.1934	0.2563	0.1342	0.1934	0.2564	0.1346	0.1934	0.2655

**Table 8**  
Consumption Smoothing

	Benchmark			$\theta = 0.50, q^* = 0.10$			$\theta = 0.50, q^* = 0.20$		
	Coll	HS	NHS	Coll	HS	NHS	Coll	HS	NHS
Intra	0.1087	0.1728	0.2363	0.1096	0.1729	0.2364	0.1120	0.1740	0.2374
Inter	0.0254	0.0206	0.0200	0.0252	0.0205	0.0200	0.0250	0.0204	0.0199
Total	0.1341	0.1934	0.2563	0.1348	0.1934	0.2564	0.1370	0.1944	0.2573

**Table 9**

Welfare Gains from Loan Guarantees

$q^*$	0.05	0.1	0.2
	$\theta = 0.25$		
	-0.053%	-0.053%	-0.049%
	$\theta = 0.5$		
	-0.118%	-0.111%	-0.111%



**Table 10**  
Taxes

$\theta = 0.25$				
$q^*$	0.0	0.05	0.1	0.2
$\tau$	0.0%	0.059%	0.060%	0.061%
$\theta = 0.5$				
$q^*$	0.0	0.05	0.1	0.2
$\tau$	0.0%	0.134%	0.156%	0.195%

Figure 1: Intertemporal Consumption Smoothing, Expected Utility

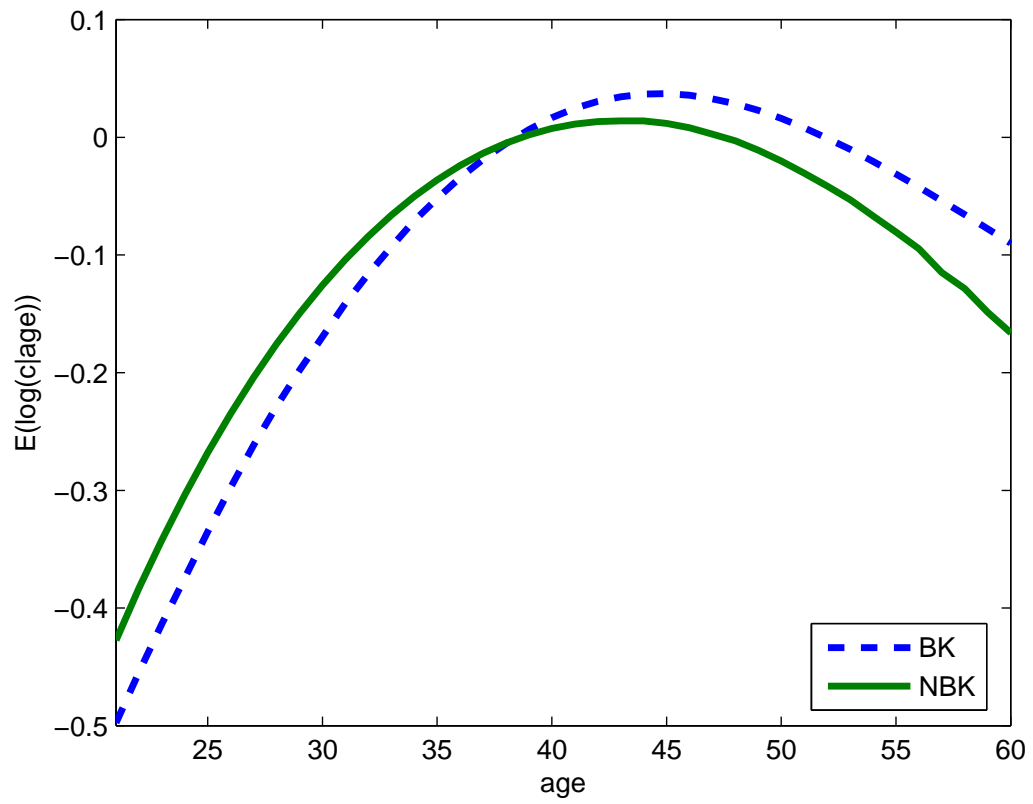


Figure 2: Intratemporal Consumption Smoothing, Expected Utility

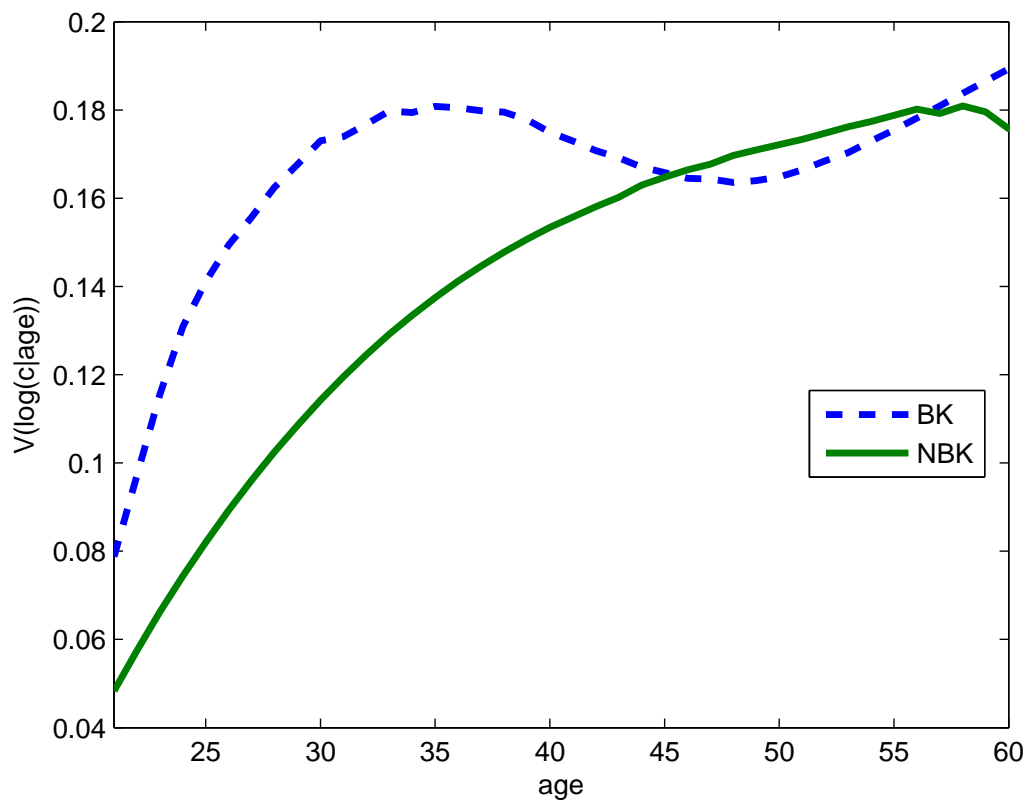


Figure 3: Pricing, Expected Utility

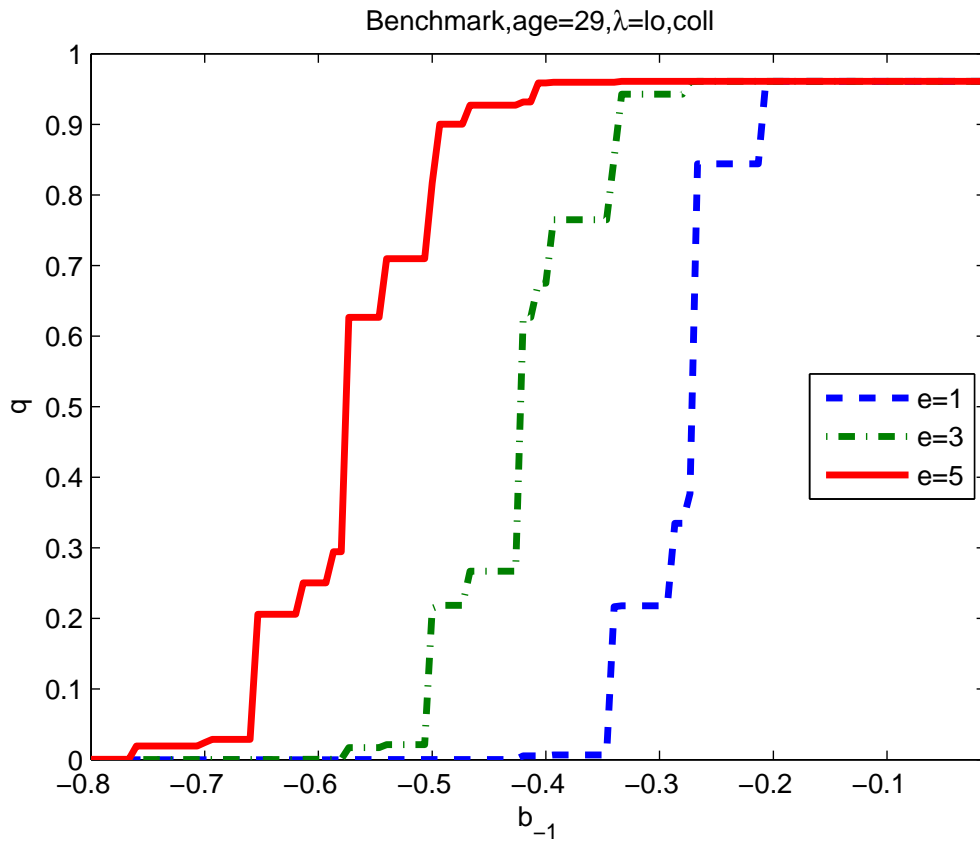


Figure 4: Pricing, Expected Utility

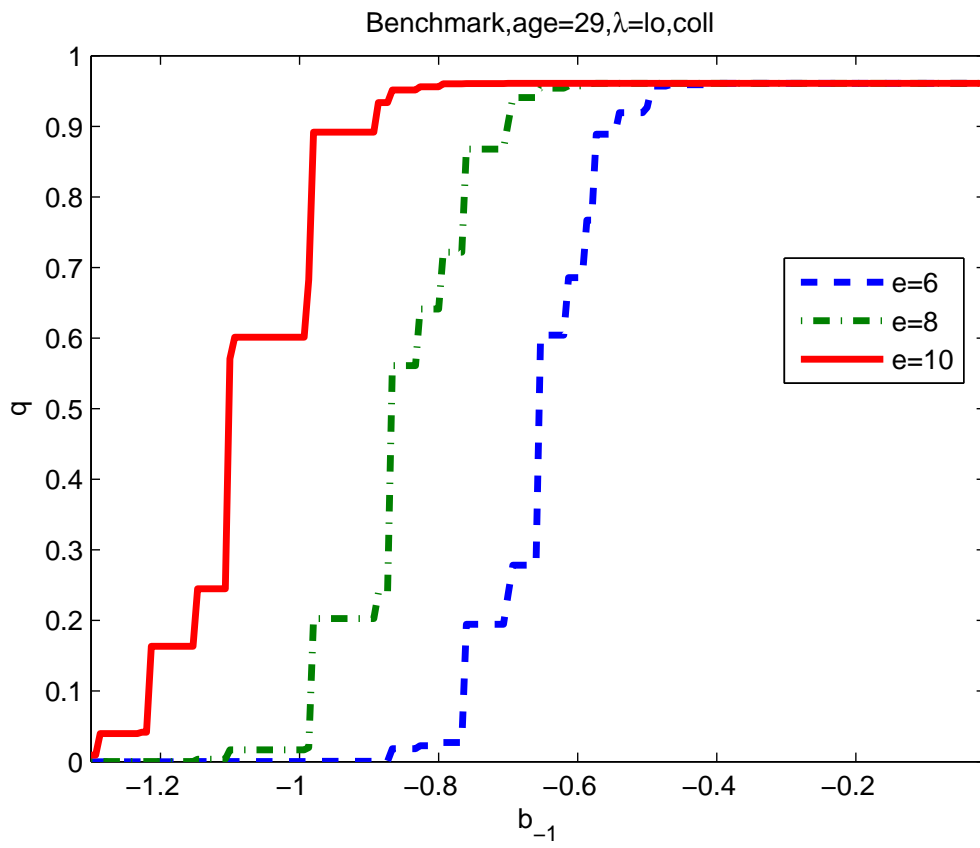


Figure 5: Pricing, Expected Utility

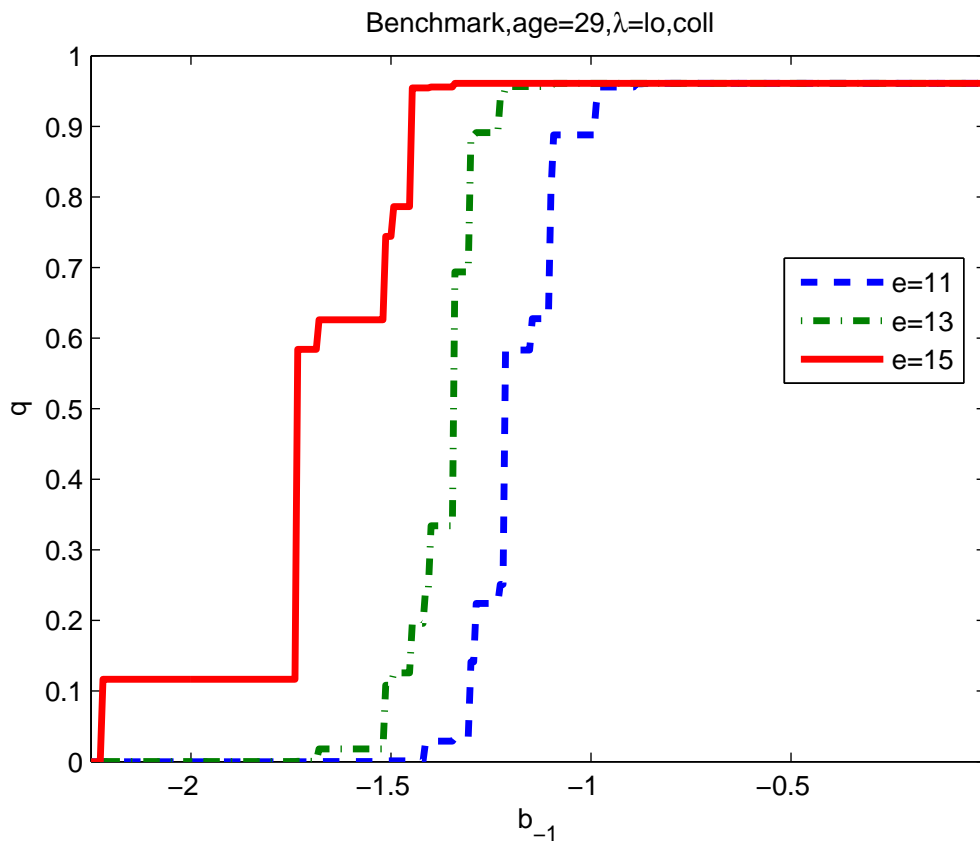


Figure 6: Fraction Supporting Bankruptcy, BK Regime

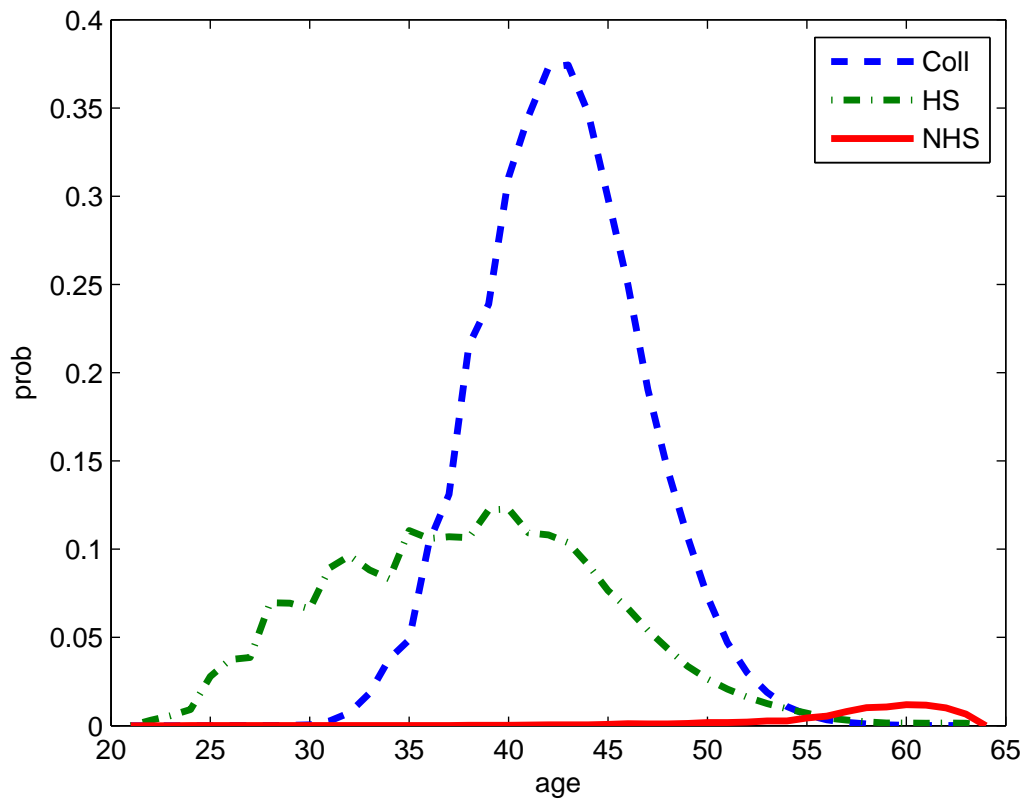


Figure 7: Fraction Supporting Bankruptcy, NBK Regime

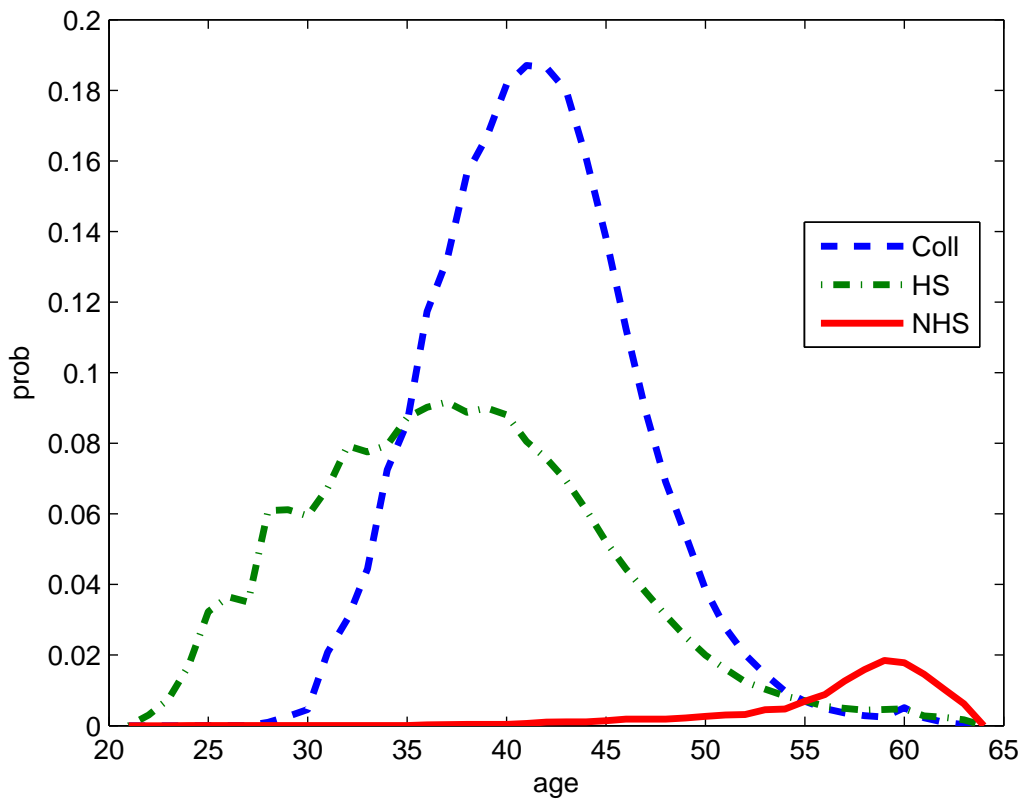




Figure 8: Pricing, Epstein-Zin with Different EIS

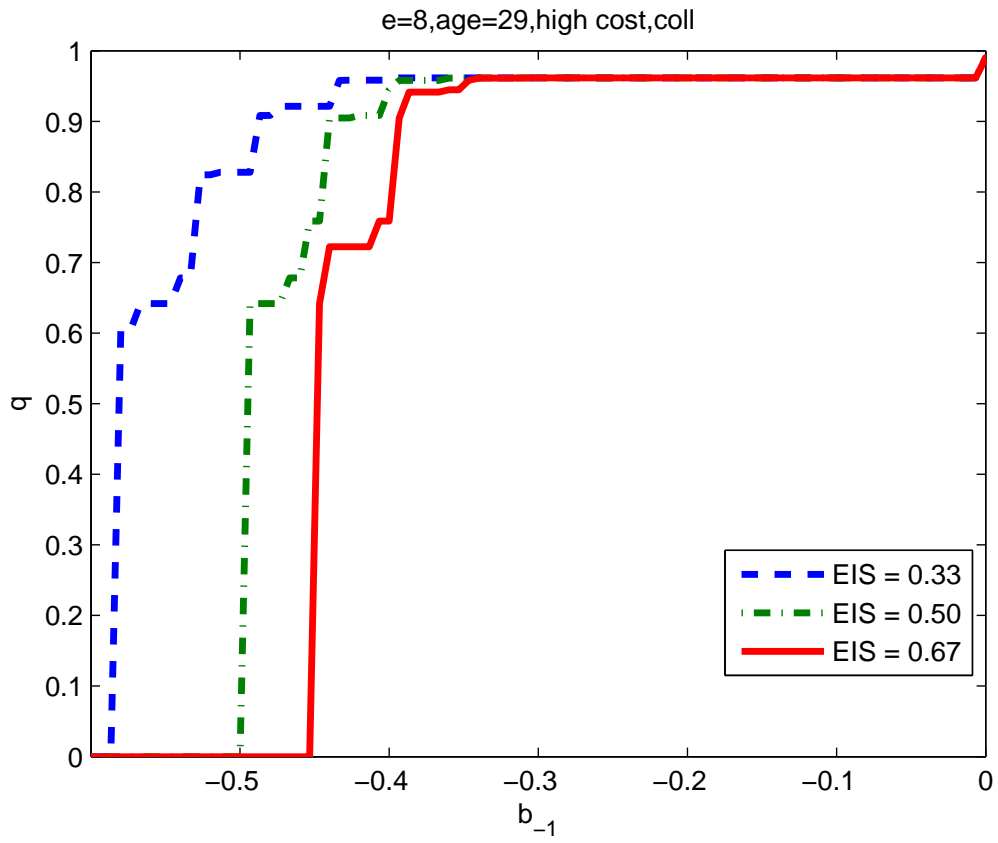


Figure 9: Pricing, Epstein-Zin with Different Risk Aversion

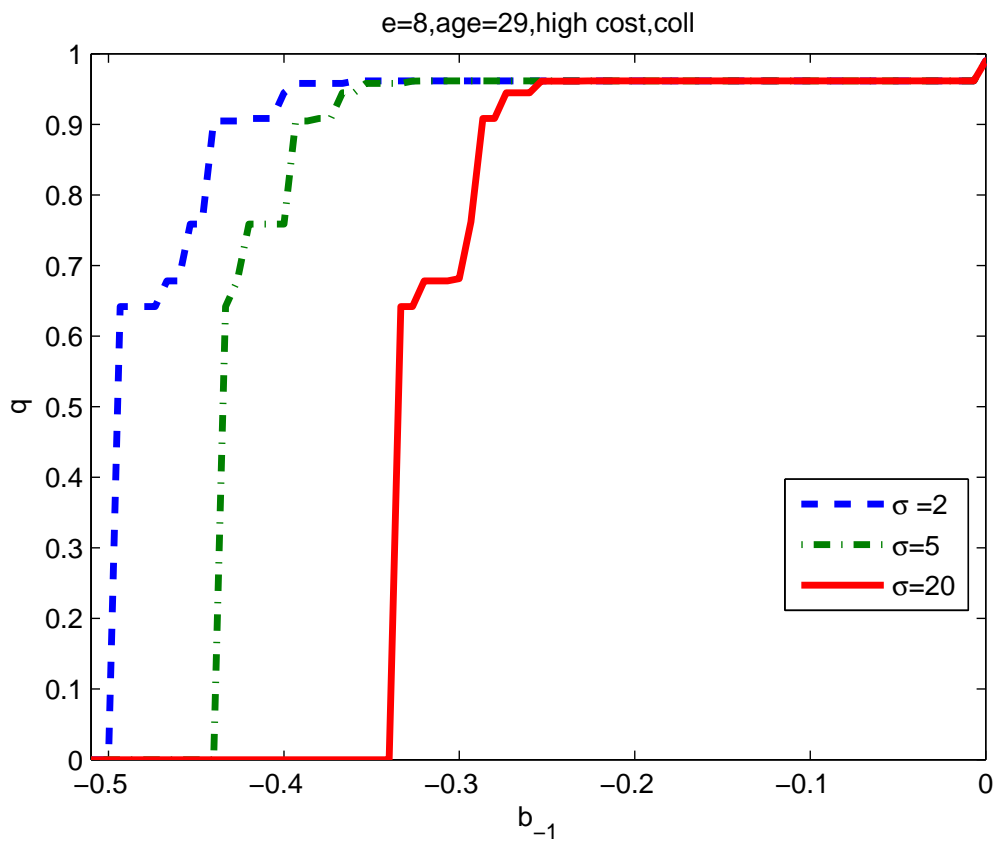


Figure 10: Welfare Gains from Eliminating Bankruptcy

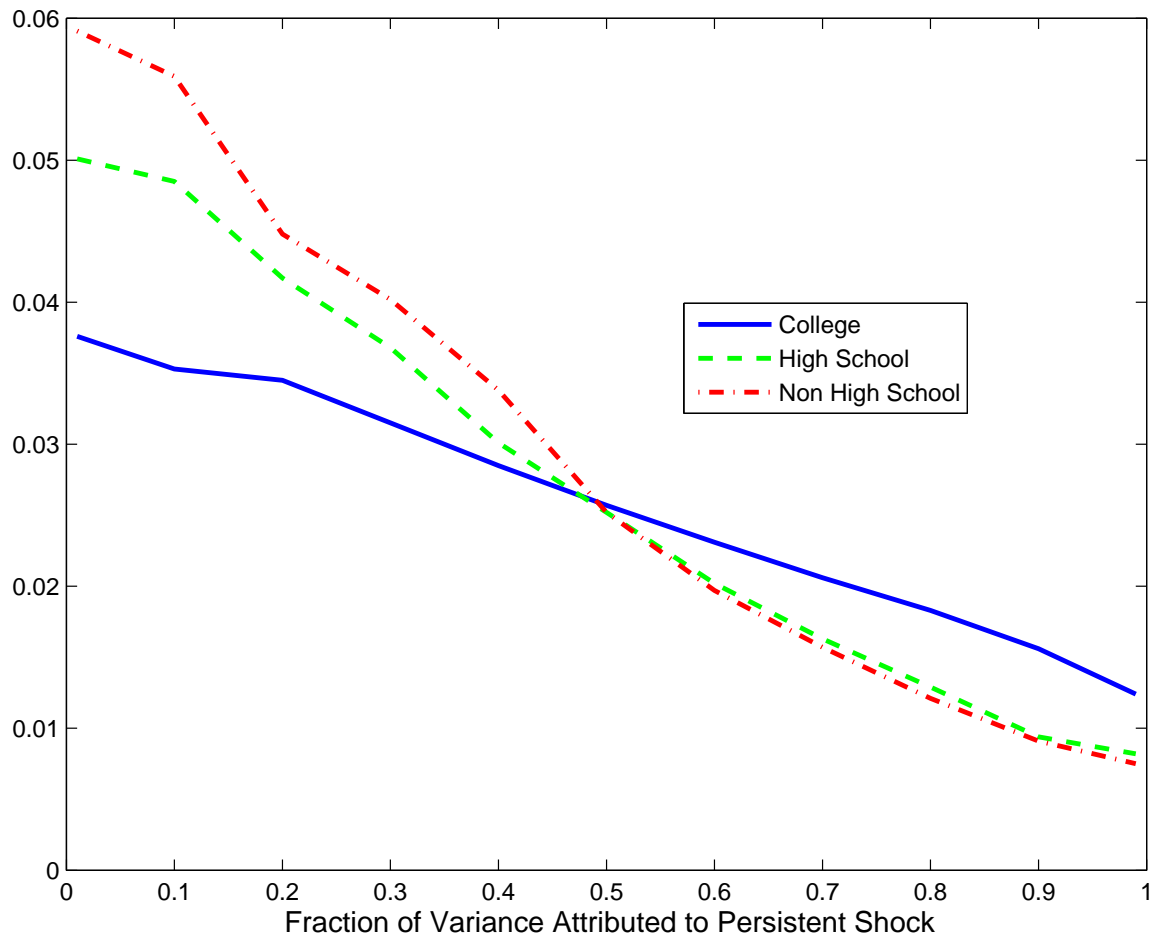


Figure 11: Fraction of Borrowers

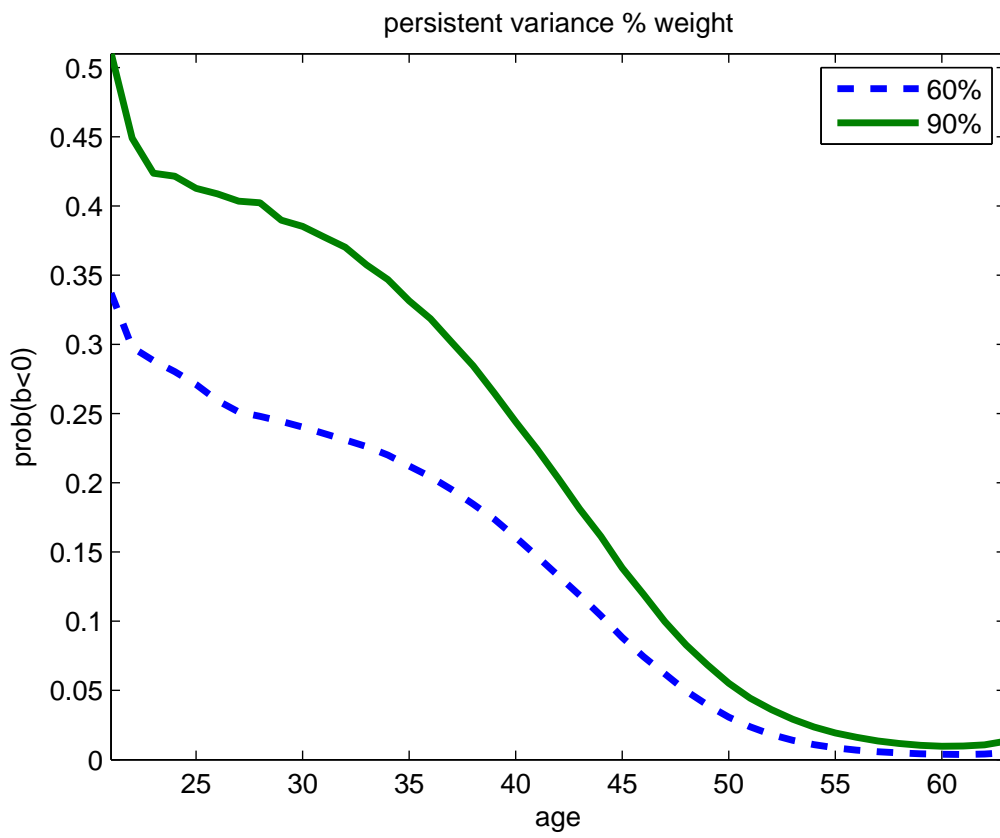


Figure 12: Mean Debt of Borrowers

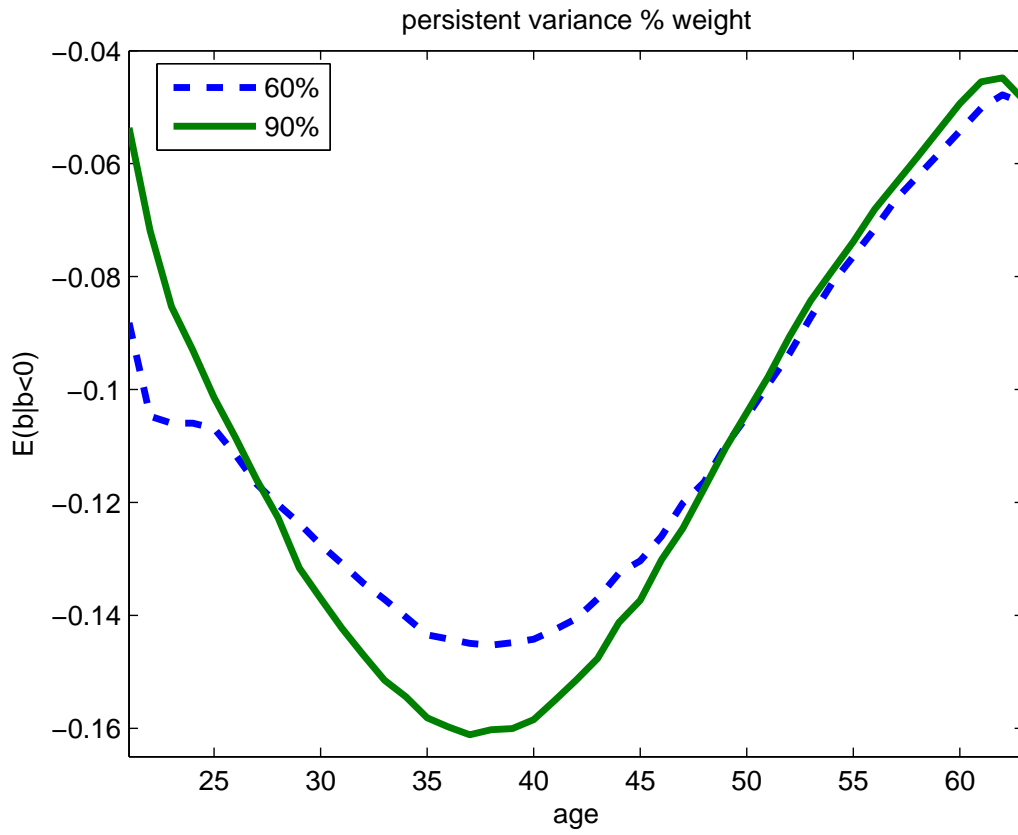


Figure 13: Default Rates

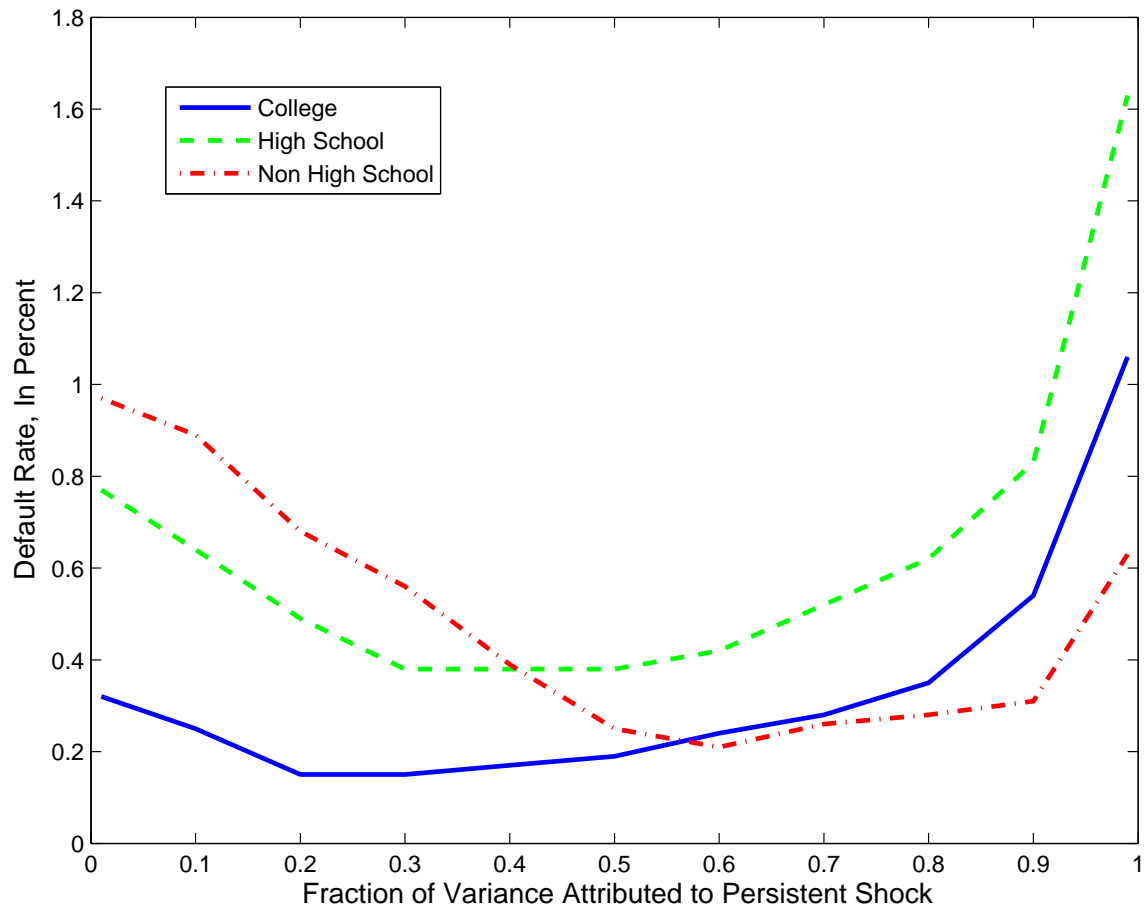


Figure 14: Pricing Functions

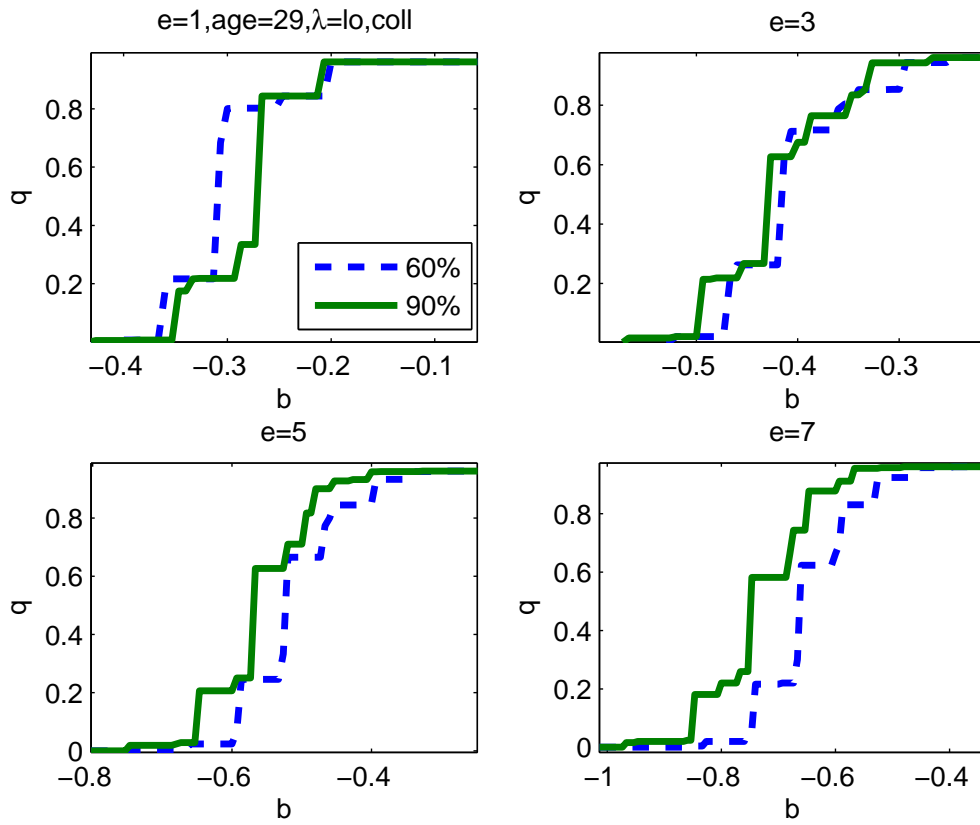


Figure 15: Pricing, Ambiguity Aversion, High  $e$

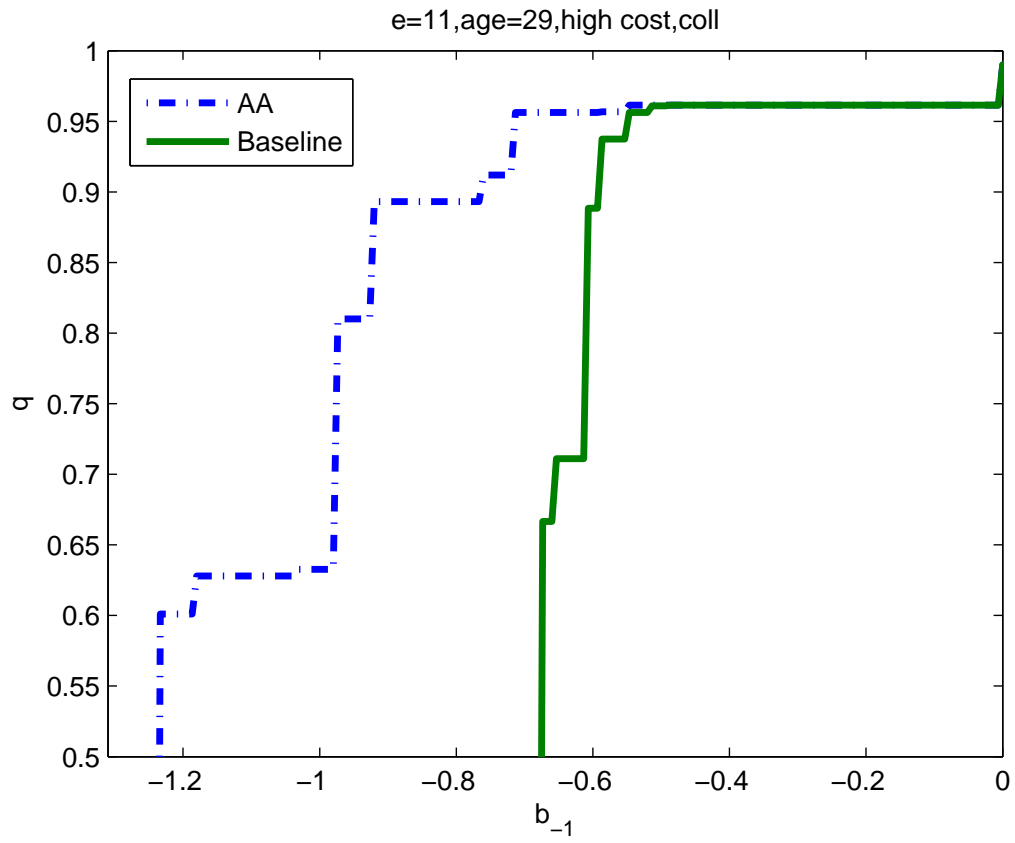




Figure 16: Pricing, Ambiguity Aversion, Low  $e$

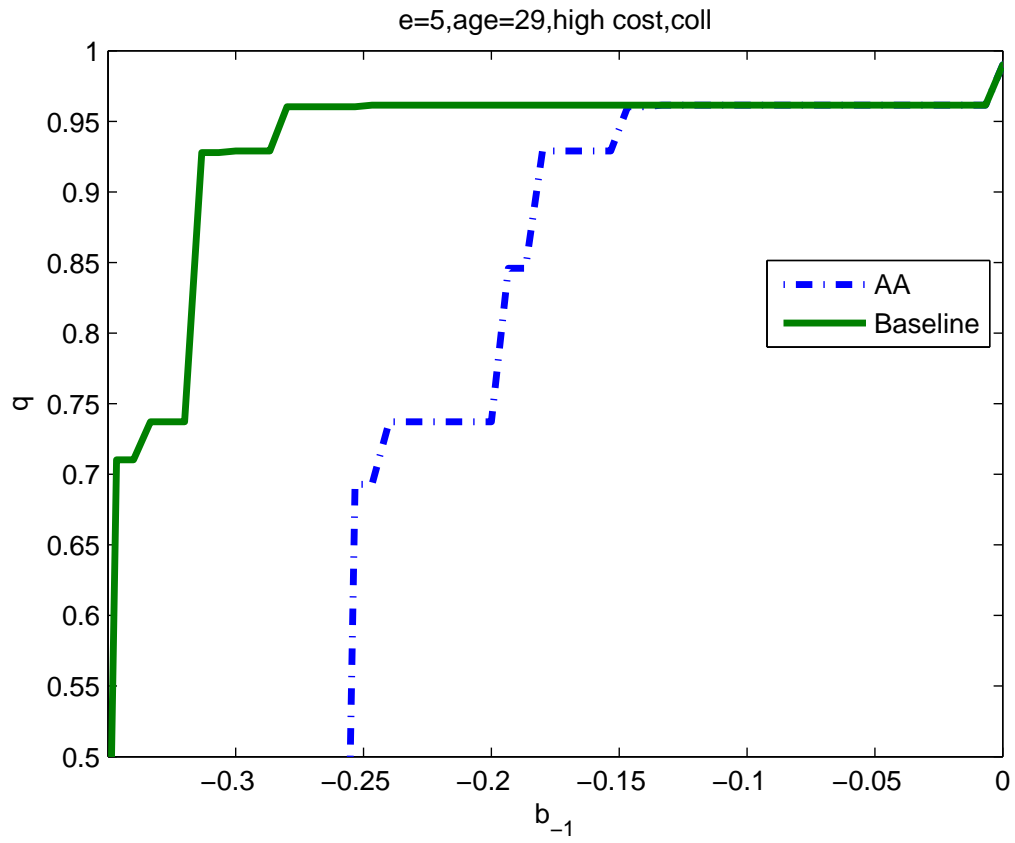


Figure 17: Pricing, Loan Guarantee

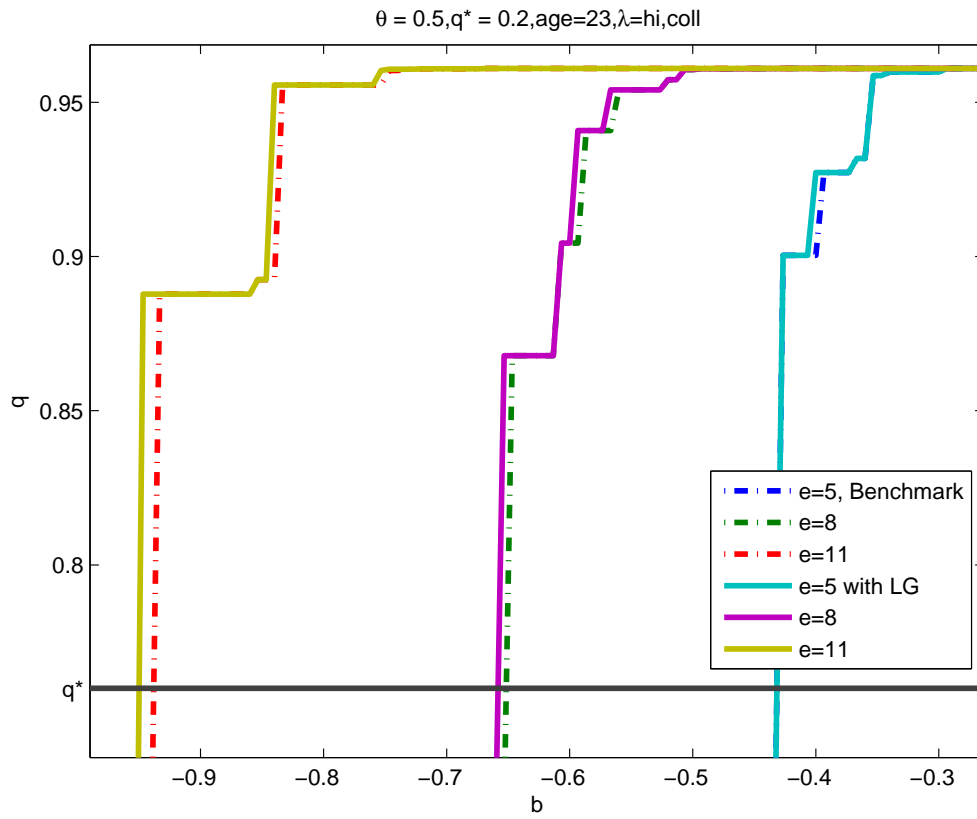


Figure 18: Pricing, Loan Guarantee

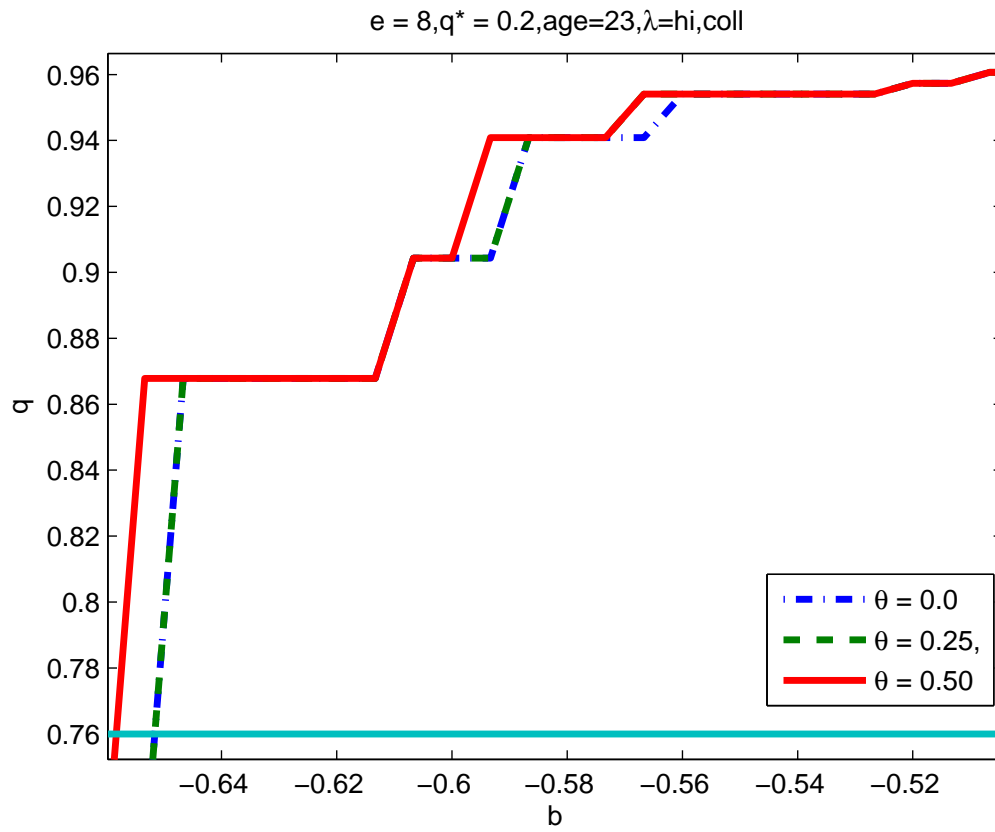


Figure 19: Default by State

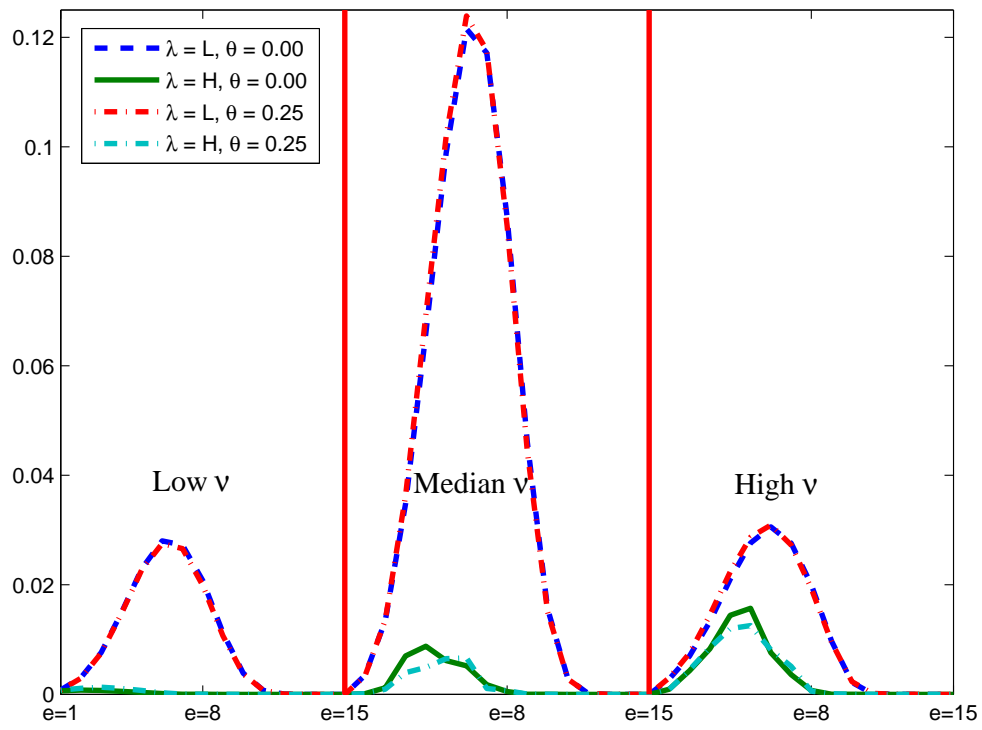


Figure 20: Optimal Choice of  $b$  given  $q$

