Redistributive Labor-Income Taxation and Bankruptcy in US States*

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PRELIMINARY

Abstract

Both bankruptcy regulation and redistributive taxation vary considerably across US states. We model the interactions between these two policies: redistributive taxation targets intratemporal inequality whereas asset exemptions in bankruptcy procedures help agents to smooth consumption across time. We derive sufficient conditions under which more redistributive taxation makes bankruptcy exemptions less attractive both with respect to the intratemporal-insurance and intertemporal consumption-smoothing motive. In particular, more persistent shocks can make bankruptcy exemptions less attractive because they create credit constraints, but this effect is less important if agents receive redistributive transfers. Using data for 18 US states in the time period 1980-99 we find considerable support for our model's predictions: (i) redistributive taxation and bankruptcy exemptions are negatively correlated; (ii) both policies are associated with more equal consumption growth whereas the effect on household debt is less clear-cut.

Keywords: Personal bankruptcy, Consumer credit, Redistributive taxes and transfers.
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1 Introduction

Bankruptcy regulation and redistributive taxation are both important policies in the US. An average US household receives $1,000 in direct transfers per year (see the authors' calculation based on the CPS in table 3). At the same time, roughly 1.5% of US households have filed for personal bankruptcy in each recent year; in 2003 households defaulted on approximately $120 billion or $1,100 per household each year (see White, forthcoming). Besides the aggregate importance of both policies, there is substantial variation in the regulation of bankruptcy and redistribution across US states. For example, bankruptcy exemptions (the assets that may be kept by the debtor when he defaults on his debt) are generous in Texas where housing property is fully exempt regardless of value (although subject to an acreage limit) but redistribution through taxes and transfers is less pronounced. In contrast, New York allows for much smaller bankruptcy exemptions but has a more generous redistribution scheme through taxes and transfers.

In this paper we argue that this negative correlation between the two policies can be explained because both policies help households to insure some of the income fluctuations that they are not otherwise able to insure if markets are incomplete (for empirical evidence on the lack of consumption insurance in the US see, for example, Attanasio and Davis, 1996, or Blundell et al., 2004). Both personal bankruptcy and redistributive taxes are attractive for agents in this second-best world but this attraction is reduced in the presence of the other policy. This is far from obvious since the main motive for taxes and transfers is to redistribute resources intratemporally whereas the bankruptcy exemption is crucially associated with intertemporal consumption-smoothing (it is only important if agents save and borrow across time). Although, in reality, a tax and transfer system could be used to reallocate resources across time (think of a pension scheme), we abstract from this in our model. This allows us to contrast the crucial differences between the two policies in a simple stylized way.

Bankruptcy legislation provides a 'fresh start' for agents who have been hit by a sufficiently bad shock (see for example Hynes, 2002). Bankruptcy provides insurance since households with bad shocks default while those who repay, pay higher interest rates. As we will see below, redistributive taxes and transfers make this fresh start less attractive since they already eliminate some of the ex-post inequality in gross income. Moreover, redistributive taxation decreases agents' expected differences in income across time and thus their desire to borrow. Besides these intuitive and straightforward interactions, we point out more subtle ways in which redistributive taxation changes the costs and benefits of personal bankruptcy. In particular, we derive intuitive sufficient conditions under which both policies are substitutes in providing partial insurance and show how this depends on the persistence of the shocks. These results are interesting and help us to better understand the interaction between both policies at the micro level.

We provide empirical evidence that considerably supports the model's hypotheses. We use data from the Consumer Expenditure Survey (CEX) for consumption, the Current Population Survey (CPS) for income and construct measures for bankruptcy exemptions and redistributive taxation for 18 US states in the period 1980-99. We find that the level of the bankruptcy exemption and the extent of redistributive taxation are negatively correlated. A generous exemption is associated with less redistribution through taxes and transfers, suggesting that both policies are substitutes. Moreover, to support our theoretical perspective, we provide more direct evidence that both policies are important for the smoothing and insurance motive. Both the bankruptcy exemption and redistributive taxation are associated with less inequality in consumption growth (which directly measures consumption insurance); whereas the effect of both policies on the amount of unsecured household debt is less clear-cut.

Of course, we are not the first to analyze bankruptcy or redistributive taxation in the US. For example, Gropp et al. (1997) investigate the effect of personal bankruptcy on the amount household's borrow, while Zame (1993) and his references show theoretically how bankruptcy can provide partial insurance against income fluctuations (see also Grant, 2001, for empirical evidence). In the context of the recent bankruptcy reforms, Athreya (1999) and Chaterjee et al. (2002) calibrate numerical models to gauge how the benefits of bankruptcy compare with the costs, such as higher interest rates. It is also well-known that redistributive taxation provides partial insurance if financial markets are incomplete (see the seminal paper of Varian, 1980, and the empirical evidence in Grant et al., 2003, and their references).

However, to the best of our knowledge, this paper is the first attempt to jointly analyze redistributive taxation and bankruptcy exemption focussing on the intra- and intertemporal channels of policy interaction. Most related in this respect are the analyses of Athreya and Simpson (2003) and Bertola and Koeniger (2004). As in this paper, Bertola and Koeniger analyze interactions between redistribution and financial market imperfections (see also Hansen and Imhoroglu, 1992). They argue that in a second-best world of incomplete financial markets, more compressed labor income can mitigate the adverse welfare effect of credit constraints. The interactions between redistribution and bankruptcy in this paper are similar in spirit. But since we allow for bankruptcy, the interactions between financial market imperfections and redistribution now has effects on both the interest rate and the level of borrowing. Allowing for bankruptcy has the additional advantage that we are able to test the predictions of the model with data on US states which vary in the way they regulate bankruptcy as well as redistributive taxes and transfers.

Whereas our simple model allows us to derive some analytical results for a quite general class of utility functions and probability distributions, Athreya and Simpson (2003) numerically solve a fully dynamic model to analyze interactions between public insurance and bankruptcy quantitatively. In their model, market imperfections such as moral hazard play an important role. On the one hand, bankruptcy might reduce search effort of unemployed agents because it shelters the consumption of agents especially from long-term shocks. On the other hand, lower unemployment insurance increases search effort, reduces the unemployment rate, and thus also lowers default rates. Although problems of hidden action or asymmetric information are certainly important in the real world, we show in this paper that such imperfections are not necessary to rationalize why bankruptcy is less attractive if redistribution is more pronounced, and we believe it is important to first understand this simpler environment. Moreover, we do not have the data to exploit a richer modelling framework in the empirical part. Thus, we rather view our approach as complementary to the one chosen by Athreya and Simpson.

The rest of the paper is structured as follows. In Section 2 we present a simple model that analyzes interactions between redistributive taxation and bankruptcy exemption. We describe the data in Section 3 and discuss the econometric specification in Section 4. We present our empirical results in Section 5 before we conclude in Section 6.

2 A model

We construct a simple model with three periods labelled 0 to 2 in which the bankruptcy decision is modelled in a standard way (see, for example White, forthcoming). This simple model allows us to derive some analytic results for a relatively general class of utility functions and probability distributions that illustrate the interactions between a linear redistributive tax/transfer scheme and a bankruptcy exemption.

Agents are risk-averse and either borrow at interest rate r_t from risk-neutral banks, or lend at the world risk-free interest rate r_f. The interest rate r_t is endogenously determined and incorporates the bank's expectation about the agent's repayment behavior. Thus, the interest rate r_t will depend on each agent's circumstances (although we have dropped the agent-specific index for convenience). In contrast, the world interest rate r_f is exogenous and constant. Since the probability of default is weakly larger than zero, $r_t \geq r_f$.

There is a continuum of agents of mass 1. Half of these agents are born in period 0 with liabilities b_0 and half are born with assets a_0. We take these initial financial positions as given. In period 1 these positions imply liabilities $b_0(1+r_1)$ or wealth $a_0(1+r_f)$. In period 1 agents receive an uncertain endowment $\omega_1 = \mu_1 + \varepsilon_1$ where μ_1 is known and ε_1 is random with mean zero. We continue to omit the agent-specific index since choices can be characterized for a representative borrower and lender as a function of resources and the realized endowment draws. After the draw of the period 1 endowment, agents decide whether or not to declare bankruptcy. Then, they decide how to change their asset position, i.e., whether to borrow or save, and how much to consume. In period 2, agents receive another endowment draw

$$\omega_2 = \mu_2 + \alpha\varepsilon_1 + \varepsilon_2 \quad \text{where} \quad 0 \leq \alpha \leq 1 \ .$$

If $\alpha = 0$, then ω_1 and ω_2 are independently distributed. If instead $\alpha = 1$, the shock ε_1 in the first period is permanent. For $\mu_2/\mu_1 > 1$, agents in period 0 expect their endowment to grow. Since all that matters for agents borrowing behavior is the ratio μ_2/μ_1, we normalize $\mu_1 = 1$ and define $\mu \equiv \mu_2/\mu_1$.

Finally, after their endowment draw in period 2, agents decide whether to declare bankruptcy and how much to consume. Given this setup, total resources in period t (before the decision to declare bankruptcy) are defined as

$$\rho_t = \begin{cases} \omega_t - (1+r_t)b_{t-1} & \text{if borrow} \\ \omega_t + (1+r_f)a_{t-1} & \text{if lend.} \end{cases}$$

Depending on whether the agent has carried positive assets a_t or debt b_t from the previous period, the total resources are larger or smaller than the current endowment ω_t.

We now introduce the policies into the model. Agents are taxed or receive transfers depending on the level of their resources ρ_t. We define ρ^+ so that agents with resources $\rho_t < \rho^+$ receive transfers whereas agents with resources $\rho_t > \rho^+$ are taxed. In particular, we assume a linear tax/transfer schedule

$$\tau(\rho_t - \rho^+).$$

This tax-schedule conveniently summarizes redistribution in the parameter τ where we assume the tax schedule is constant over time. For example, a larger τ not only implies a larger marginal tax rate in good states (e.g. for high draws of ε_t) but also larger transfers in bad states. Notice that the assets of agents are taxed, and debt and its interest can be deducted as is realistic in the US for most of our sample period although tax reforms have implemented some changes (see Makin, 2001). Moreover, we do not explicitly model the deadweight loss resulting from this policy. We will discuss this issue further below. We now are able to define net resources of the agent as

$$\widetilde{\rho}_t \equiv \rho_t - \tau(\rho_t - \rho^+).$$

Agents declare bankruptcy[1] if they have borrowed and their total net resources fall below the exemption level x,

$$\widetilde{\rho}_t < x$$

and note that we implicitly assume here, as is realistic, that the agent first pays taxes and receives transfers before he makes the bankruptcy decision.

The critical level of gross resources below which the agent declares bankruptcy is

$$\rho_t^* = \frac{x - \tau\rho^+}{1-\tau}.$$

Not surprisingly, agents declare bankruptcy at a higher level of net resources if the exemption level x is higher. In contrast, the effect of τ on ρ_t^* depends on whether agents are net tax payers or receive transfers at the exemption level x (whether ρ^+ is greater or less than x). If agents receive transfers at a higher level of resources than the exemption level, that is $\rho^+ > x$, then $\partial\rho_t^*/\partial\tau < 0$. In contrast, $\partial\rho_t^*/\partial\tau \geq 0$ if $\rho^+ \leq x$. For later reference note that the critical value in terms of endowments is given by

$$\omega_t^* = \frac{x - \tau\rho^+}{1-\tau} + (1+r_t)b_{t-1}. \tag{1}$$

In our simple model bankruptcy only matters for agents who borrow, thus we focus on these agents in our analysis below while mentioning how lenders are affected by redistributive taxation. We start by analyzing the problem of a borrowing agent by backward induction. We first characterize the decision whether to declare bankruptcy in period 2 for a given level of borrowing b_1. In particular, we are interested how this decision changes for different tax rates τ. We then analyze how the level of borrowing in period 1, b_1, depends on the two policies x and τ, for a given interest rate r_2. For these two decisions we are able to provide analytic results for a general class of utility functions and probability distributions. However,

[1] We will comment on the static nature of this bankruptcy decision below.

we need to parameterize both utility and probability in order to characterize the equilibrium in period 1 (for endogenous b_1 *and* r_2). Finally, we compute the borrowers' indirect utility as a function the two policy parameters in period 0 and show how optimal exemption depends on redistributive taxation and the persistence of shocks.

2.1 Intratemporal insurance and policy substitutability period 2

Bankruptcy in period 2 matters only for agents who borrow in period 1, hence we first derive which agents find it optimal to borrow. To do this, we need to define net resources in period 1 after the agent has decided whether to declare bankruptcy:

$$\tilde{\rho}_1^b = \begin{cases} \rho_1 - \tau(\rho_1 - \rho^+) & \text{if } \omega_1 > \omega_1^* \\ x & \text{if } \rho_1^* \leq \omega_1 \leq \omega_1^* \\ \omega_1 - \tau(\omega_1 - \rho^+) & \text{if } \omega_1 \leq \rho_1^*. \end{cases}$$

Above the endowment threshold for bankruptcy ω_1^* agents fully repay. In the interval $(\rho_1^*; \omega_1^*)$ they are fully insured by bankruptcy that exempts resources up to x - they are fully insured since their consumption does not change with income in this region. For endowments below ρ_1^* agents fully default on their debt but resources are below the exempt amount and thus no longer independent of the endowment draw. Moreover, in this region, since consumption falls as income falls, they are less than fully insured. We discuss this further below.

Personal bankruptcy only matters in period 2 if agents have borrowed in period 1. Borrowing is optimal if the marginal utility in period 1, evaluated at net resources $\widetilde{\rho}_1^b$, is larger than the expected marginal utility in period 2 conditional on repayment (evaluated at the net endowment). That is:

$$u'(\widetilde{\rho}_1^b) > \beta(1 + r_2) \int_{\omega_2^*}^{\infty} u'(\widetilde{\omega}_2) f(\omega_2) d\omega_2, \tag{2}$$

where $u(.)$ is a strictly concave, continuous and differentiable utility function, primes denote derivatives, ω_t^* is the endowment below which the agent declares bankruptcy, β is the discount factor, and r_2 is the interest rate at which the agent can borrow in period 1. Moreover, $\widetilde{\omega}_2 = \omega_2 - \tau(\omega_2 - \rho^+)$ is the net endowment in the second period if the agent has zero assets (no debt). The threshold of the endowment in the second period below which the agent declares bankruptcy is $\omega_2^* = \rho_2^*$ in this case since the agent has a zero asset position.

In period 2 the utility of an agent who has borrowed is

$$
\begin{aligned}
u_2^b \;=\; & \int_{\omega_2^*}^{\infty} u((\underbrace{\omega_2-(1+r_2)b_1}_{=\rho_2})(1-\tau)+\tau\rho^+)f(\omega_2)d\omega_2 \\
& + \int_{\rho_2^*}^{\omega_2^*} u(x)f(\omega_2)d\omega_2 \\
& + \int_{-\infty}^{\rho_2^*} u(\omega_2(1-\tau)+\tau\rho^+)f(\omega_2)d\omega_2
\end{aligned} \tag{3}
$$

where the density of the distribution is assumed such that expected marginal utility remains finite on the support of the distribution.

The first line of expression (3) contains the utility of a borrowing agent if he repays in period 2. The second line is the utility if the bankruptcy exemption provides full consumption insurance. And the third line is the utility if the endowment in period 2 is so low that the bankruptcy exemption only provides partial insurance. Note that, as is realistic, agents who default on their debt cannot default on tax payments and can no longer tax deduct their debt and interest payments.

We illustrate the insurance provided by the bankruptcy exemption in the left picture of Figure 1 (we discuss the Figure further after Remark 2 below). We plot consumption (the solid line) and net resources (the dashed line) as a function of the gross endowment. The bankruptcy exemption reduces consumption in good states (in equilibrium, agents pay more interest when they repay, which we discuss below) and provides insurance in bad states. Thus, the bankruptcy exemption facilitates intertemporal consumption smoothing by redistributing resources across states in the second period. If the gross endowment is in the interval $(\rho_2^*;\omega_2^*)$ the bankruptcy exemption provides full insurance so that consumption is flat. Agents default partially on their debt. For endowments $\omega_2 < \rho_2^*$ agents fully default on their debt (the consumption increase afforded by bankruptcy is largest as measured by the distance between the solid and dashed line at a given endowment level) but consumption is no longer constant so that insurance is only partial. That is, in this region, even though they default on more debt, their level of consumption is falling as their endowment falls.

For agents who decide in period 1 to hold assets a_1, utility in period 2 is

$$
u_2^s = \int_{-\infty}^{\infty} u([\omega_2+(1+r_f)a_1]\,(1-\tau)+\tau\rho^+)f(\omega_2)d\omega_2 \tag{4}
$$

where a_1 are the assets the agent carries from period 1 to period 2 and r_f is the exogenous risk-free world interest rate. Note that the utility of savers only depends on taxes but is unaffected by the exemption x for given a_1. Thus, in the following we focus on the utility of borrowers to investigate the interaction of the two policies in period 2. As a first step, we now show how the interest rate r_2 of the borrowers is determined and depends on the policy parameters.

2.1.1 Determination of the interest rate

A risk neutral bank in a competitive banking market sets the interest rate r_2 so that it receives the same expected return as lending on the world market at the risk free rate r_f. The arbitrage condition is

$$\int_{\rho_2^*+\frac{C}{1-\tau}}^{\omega_2^*}(\omega_2 - x - C - \tau(\omega_2 - \rho^+))f(\omega_2)d\omega_2 + \int_{\omega_2^*}^{\infty}(1+r_2)b_1 f(\omega_2)d\omega_2 = b_1(1+r_f) \quad (5)$$

where C is the deadweight bankruptcy cost. This cost is borne by the bank, and reflects such things as administrative and judicial costs.[2] The first integral in the arbitrage equation is the expected repayment in the states of the world in which the agent partially defaults whereas the second integral is the expected repayment in the states of the world in which the agent fully repays.[3]

Totally differentiating equation (5) using Leibniz rule, we find that for a given level of borrowing:

$$\left.\frac{dr_2}{dx}\right|_{b_1} = \frac{F(\omega_2^*) - F(\rho_2^* + \frac{C}{1-\tau}) + \frac{C}{1-\tau}f(\omega_2^*)}{(1-F(\omega_2^*))\,b_1 - Cf(\omega_2^*)b_1} > 0 \quad (6)$$

The derivation is given in Appendix A. The intuition is that a higher exemption level x raises the proportion of households defaulting (recall equation 1). This increases the interest rate which reflects the higher risk of default. If there is no deadweight loss, so that $C = 0$, the size of the effect depends positively on the ratio of the probability of bankruptcy with partial default, $F(\omega_2^*) - F(\rho_2^*)$, over the probability of full repayment $1 - F(\omega_2^*)$. Notice that the exemption has only an effect on the interest rate if the exemption decreases the repayment to the bank; that is, in the states of nature in which the agent fully defaults and pays nothing,

[2] If the cost was borne by the agent, for example as pure utility cost, the bankruptcy cost would affect the threshold ω_2^*. In this case, the cost would enter the arbitrage equation (5) only through its effect on the bounds of the integral but no longer by lowering the payment of the agent. In this case the sufficient condition of Remark 1 simplifies to the decreasing hazard property without additional restrictions on the bankruptcy cost.

[3] Note that we implicity assume that the bank does not incur the bankruptcy cost if the agent fully defaults. This assumption is not essential but is reasonable in our model since it is unclear why the bank should care about costly procedures if it knows that it does not receive any net payment.

the exemption has no effect. For $C > 0$, $dr_2/dx|_{b_1}$ increases since the bankruptcy cost is borne by the bank. Furthermore, we can show the following:

Remark 1: *For a given level of borrowing b_1 and negligible bankruptcy cost ($C = 0$), a higher tax/transfer τ increases the costliness of the exemption in terms of larger interest payments:*

$$\frac{d\left(\frac{dr_2}{dx}|_{b_1} b_1\right)}{d\tau} > 0 \tag{7}$$

if

$$\frac{f(\rho_2^*)}{1 - F(\rho_2^*)} > \frac{f(\omega_2^*)}{1 - F(\omega_2^*)} \left| \frac{\partial \omega_2^* / \partial \tau}{\partial \rho_2^* / \partial \tau} \right| .$$

If $|\partial \omega_2^* / \partial \tau| > |\partial \rho_2^* / \partial \tau|$ a necessary condition is that the probability distribution has decreasing hazard on the interval $(\rho_2^*; \omega_2^*)$. Otherwise decreasing hazard is a sufficient condition.

Proof: see Appendix A.

The decreasing hazard property implies that the expected cost of bankruptcy in terms of larger interest payments increases (in the states of nature in which the agent repays). If agents receive transfers at resources smaller or equal than the bankruptcy threshold, the interval $(\rho_2^* \,;\, \omega_2^*)$ in which the bankruptcy exemption provides full insurance "shifts to the left". With decreasing hazard, this shift induces the bank to increase the interest rate to break even because the relative probability mass associated with bankruptcy increases relative to the mass associated with repayment. If $C > 0$, the condition to sign the derivative in Remark 1 can no longer be interpreted in a straightforward way. As inspection of equation (6) suggests, for $C > 0$ the shape of the density also becomes important.

2.1.2 Policy interactions

We now turn to the welfare effect of x and τ for agents who borrow in period 2. Totally differentiating (3) with respect to the exemption x we find for given b_1 that

$$\begin{aligned} \frac{du_2^b}{dx}|_{b_1} &= -(1-\tau) b_1 \frac{dr_2}{dx}|_{b_1} \int_{\omega_2^*}^{\infty} u'((1-\tau)\rho_2(\omega_2) + \tau\rho^+) f(\omega_2) d\omega_2 \\ &\quad + \left(F(\omega_2^*) - F(\rho_2^*)\right) u'(x) \end{aligned} \tag{8}$$

The first line of the derivative captures the cost of the bankruptcy exemption because of higher interest payments in the good states of the world. This effect is less important if much of the interest payment can be tax deducted. The second line contains the benefit of a higher exemption in the bad states in which bankruptcy provides full insurance. For $C = \tau = 0$, equation (6) implies that banks insure agents at an actuarially fair price and the sign of $du_2^b/dx|_{b_1}$ depends on the sign of

$$u'(x) - \frac{\int_{\omega_2^*}^{\infty} u'(\widetilde{\rho}_2(\omega_2)) f(\omega_2) d\omega_2}{\int_{\omega_2^*}^{\infty} f(\omega_2) d\omega_2}$$

As in White (forthcoming), this expression is positive for risk-averse borrowers with strictly concave utility since

$$\widetilde{\rho}_2(\omega_2) \geq x \text{ for } \omega_2 \in (\omega_2^*; \infty)$$

and thus

$$u'(x) > u'(\widetilde{\rho}_2(\omega_2)) \forall \omega_2 > \omega_2^*$$

Thus, for $C = 0$, full exemption is optimal. Instead for $C > 0$ and $\tau < 1$, insurance is actuarially unfair and the welfare gains from exemptions are bounded. Nonetheless, unless bankruptcy costs are prohibitively high, some exemption will improve the welfare of borrowing agents by reducing consumption fluctuations.

Totally differentiating (3) with respect to the τ we find for given b_1 that

$$\begin{aligned} \frac{du_2^b}{d\tau}|_{b_1} &= -(1-\tau) b_1 \frac{dr_2}{d\tau}|_{b_1} \int_{\omega_2^*}^{\infty} u'((1-\tau)\rho_2(\omega_2) + \tau\rho^+) f(\omega_2) d\omega_2 \\ &- \int_{\omega_2^*}^{\infty} (\rho_2 - \rho^+) u'((1-\tau)\rho_2(\omega_2) + \tau\rho^+) f(\omega_2) d\omega_2 \\ &- \int_{-\infty}^{\rho_2^*} (\omega_2 - \rho^+) u'(\omega_2(1-\tau) + \tau\rho^+) f(\omega_2) d\omega_2 \end{aligned} \qquad (9)$$

The sign of this derivative depends on the parameters τ and ρ^+ of the tax/transfer schedule. The expected marginal-utility cost in the good states of the world in which the agent pays taxes needs to be compared with the expected gains in the bad states in which the agent receives transfers. Finally, redistribution also affects the bankruptcy decision and thus the interest rate (the first line of the derivative). For later reference it is important to note, however, that redistributive taxes and transfers lower consumption inequality and thus *ex ante* provide some insurance to agents.

We can now investigate whether the welfare gains of the bankruptcy exemption are smaller if redistribution already provides more plentiful resources in the bad states of the world. Differentiating expression (8) with respect to τ, we can show the following:

Remark 2: *For given borrowing b_1 and negligible bankruptcy cost ($C = 0$), redistributive taxation lowers the welfare gains derived from a higher bankruptcy exemption:*

$$\frac{d\left(\frac{du_2^b}{dx}|_{b_1}\right)}{d\tau} < 0,$$

if consumers cannot tax-deduct their debt and the probability distribution has increasing density and satisfies the sufficient condition in Remark 1.

Proof: see Appendix A.

The interaction between redistribution and the bankruptcy exemption in period 2 can be decomposed into five different effects (which correspond to the five lines of the derivative in the proof in the appendix). The first four effects show how more redistribution alters the cost of the bankruptcy exemption whereas the last effect captures changes in the benefits of the bankruptcy exemption:

(i) Larger transfers *increase* the cost of the bankruptcy exemption in terms of higher interest rates in the good states of the world, $\omega_2 \in (\omega_2^*; \infty)$. The sign of the effect follows from Remark 1.

(ii) A larger marginal tax rate decreases the cost of the bankruptcy exemption in terms of higher interest rates if consumers can tax deduct interest payments on their debt in the good states of the world. This makes the bankruptcy exemption more attractive if the marginal tax rate is higher.

(iii) Larger transfers in the bad states of the world imply higher taxes in the good states of the world when debt is repaid (for $\rho_2 > \rho^+$ if $\omega_2 > \omega_2^*$). The higher interest payment resulting from the bankruptcy exemptions then becomes more expensive in marginal-utility terms.

(iv) Larger transfers shift the integration bounds: agents who receive transfers declare bankruptcy only at a lower endowment ω_2. This increases the probability mass of states of the world in which the debt is repaid, and thus increases the cost of exemption in terms of a larger expected debt burden.

(v) Transfers change the probability mass of the states of the world in which exemption fully insures. If

$$f(\omega_2^*) - f(\rho_2^*) > 0$$

the probability mass decreases which makes exemption less attractive. Thus, for increasing density, more redistribution decreases the benefits of bankruptcy exemption.

Figure 1 illustrates our findings. Recall that the picture on the left plots consumption (the solid line) and net resources (the dashed lined) as a function of the gross endowment. The bankruptcy exemption reduces consumption in good states (because of a higher interest rate) and provides insurance in bad states. The picture on the right in figure 1 shows how redistributive transfers and taxes affects consumption. We have specified parameters such that the agent receives transfers in all states where he defaults. This tilts the consumption function upward in the bad states of the world and also shifts the bankruptcy threshold to the left (the consumption function is flat for relatively smaller endowments). Whether this shift of the consumption function implies that bankruptcy is less desirable cannot be deduced from the graph immediately. This is because net resources also tilt clockwise and the interest rate changes. Furthermore, it should be clear that the interaction between the two policies crucially depends on the probability mass of the distribution of resources and the changes in marginal utility attached to the shift of the consumption functions at each level of resources.

Our model setup is such that one would expect that transfers and the exemption should be substitutes in period 2. With concave utility, one would suspect that more consumption in bad states of the world raises expected utility, but that the marginal increase is lower as more is redistributed towards these states. However, we have shown that even if we only consider period 2, the interactions between the two policies are relatively rich. Redistributive transfers/taxes affect the benefit as well as the cost of bankruptcy exemption in non-obvious ways. We have shown that one crucial determinant of the sign of the policy interaction is the shape of the probability distribution, in particular the importance of increasing density and decreasing hazard in an important special case. But note that decreasing hazard and increasing density are properties on the support left of the mode of realistic and commonly used log-normal distributions. We would expect that bankruptcy exemptions are relevant especially in that region of the support.

We have derived comparative statics analyzing the *intensive* margin of the redistribution scheme τ. A similar exercise could be performed by increasing ρ^+ which implies a more *extensive* redistribution scheme (and also more intensity for endowments at which agents receive transfers). The basic insights of such an exercise are similar, so we refer the reader to Appendix A for further details.

We should mention that the government budget constraint, of course, forces tax revenue in the good states of the world to finance transfers in the bad states. We discuss this more below. Moreover, we have not allowed for either policy to affect the other's deadweight loss.

Conceptually this would be easy to model, for example, if we allowed for endogenous labor supply that is distorted by both policies. However, even with separable preferences over consumption and leisure, the sign of the interaction then depends on the sign and size of third-order derivatives of the utility function with respect to consumption and leisure. Thus, we abstract from such interactions for clarity.

We have shown under what conditions intratemporal redistribution in the second period makes exemption levels granted by bankruptcy laws less attractive. From the perspective of the second period, the policy implementation entirely depends on which policy implies less deadweight loss. We now analyze how these policies interact if we allow agents to adjust the amounts borrowed in the first period. The attractiveness of each policy then depends on the degree of intratemporal inequality and expected intertemporal inequality. In particular, more borrowing increases the size of the interval $(\rho_2^*; \omega_2^*)$ in which bankruptcy provides full insurance. Thus, depending on how redistributive are taxes or how the bankruptcy exemption changes the borrowed amounts, the exemption may become more or less attractive in period 2.

2.2 Intertemporal smoothing and policy substitutability period 1

The exemption of income in bankruptcy procedures and redistributive taxation do not only interact in terms of providing insurance in the second period. Exemption levels are more important if resources are quite unequal intertemporally. Instead, in our model, redistribution through taxation is more effective if inequality is intratemporal. Of course, the interesting case is the one with individual differences in intertemporal inequality: some agents expect to earn a higher income in the future whereas other agents do not. It is in such an environment that intratemporal and intertemporal redistribution interact since intratemporal redistribution can eliminate part of the intertemporal inequality and thus the need for bankruptcy regulation. Redistributive taxation then also affects the smoothing motive and thus also the welfare gains derived from exemption levels in bankruptcy procedures. In this section we want to analyze this interaction in more detail. We first derive some analytic results conditioning on the interest rate r_2 before we provide some numerical examples in which we allow the interest rate to adjust.

We now show that compressing the distribution of net income reduces the desire to borrow for agents who expect higher gross income in the future. To make this point formally, we characterize the amount borrowed when the Euler equation

$$u'(\widetilde{\rho}_1^b + b_1) = \beta(1+r_2)\int_{\varepsilon_2^*}^{\infty} u'(\underbrace{\mu + \alpha\varepsilon_1 + \varepsilon_2 - (1+r_2)b_1}_{=\rho_2} - \tau(\rho_2 - \rho^+))dF(\varepsilon_2) \tag{10}$$

is satisfied (implicitly we assume that the parameters are such that agents find it optimal to borrow because they are impatient enough or anticipate higher future income). Recall that $\omega_2 = \mu + \alpha\varepsilon_1 + \varepsilon_2$ and that the amount borrowed is only repaid above the bankruptcy threshold ε_2^* (the effect of borrowing on the margins of the integral in (3) cancel in the derivation of equation (10)). The bankruptcy threshold is defined as

$$\varepsilon_2^* = \frac{x - \tau\rho^+}{1-\tau} + (1+r_2)b_1 - (\mu + \alpha\varepsilon_1)$$

This threshold depends positively on expected income in the second period, $\mu + \alpha\varepsilon_1$. We show the following:

Remark 3: *For a given interest rate* r_2

- $db_1/dx|_{r_2} > 0$ *if the agent has not declared bankruptcy in period* 1;
- $db_1/d\tau|_{r_2} < 0$ *if intertemporal resources are compressed (*$\rho^+ > \rho_1$, $\rho_2 > \rho^+$*) and all agents with resources less than the exemption level receive transfers (*$\rho^+ \geq x$*);*
- $db_1/d\mu|_{r_2} > 0$ *if utility is concave enough;*
- $db_1/d\varepsilon_1|_{r_2} < 0$ *if the shock is temporary* ($\alpha = 0$).

Proof: see Appendix A.

The sign of the derivatives is intuitive. A higher exemption level x insures the agent in the bad states of the world in period 2: he will repay the debt only for relatively higher endowment realizations when the cost of repayment in marginal-utility terms is smaller. This makes borrowing more attractive (see also White, forthcoming). However, if the agent has declared bankruptcy in period 1, a larger exemption x increases his resources $\widetilde{\rho}_1^b$ which, ceteris paribus, lowers the desire to borrow.

Instead, taxation in the good states of the world in which the agent repays increases the marginal-utility cost of repayment in the second period; and transfers in the first period lower marginal utility. Both effects make borrowing less attractive. Furthermore, if a larger τ decreases the bankruptcy threshold ε_2^*, for $\rho^+ > x$, debt is repaid in states with higher marginal utility which makes borrowing less attractive.

Raising expected second period income μ makes agents willing to borrow more in the absence of bankruptcy. However, agents will also declare bankruptcy less often and this increases the marginal utility in the states of the world in which the agent repays the borrowed amount. As long as the curvature of the utility function is strong enough, the former effect dominates and higher expected second period income increases the desire to borrow for a given interest rate.

Finally, it is not surprising that a temporary good shock ε_1, ($\alpha = 0$), lowers the desire to borrow as agents try to smooth these shocks. Persistence, $\alpha > 0$, mitigates this effect. Analogously, temporary bad shocks increase borrowing but by less if endowment shocks are more persistent.

How do τ and μ affect agents who hold positive assets a_1? In this case the Euler equation is

$$u'(\widetilde{\rho}_1 - a_1) = \beta(1+r_f)\int_{-\infty}^{\infty} u'(\underbrace{\mu + \alpha\varepsilon_1 + \varepsilon_2 + (1+r_f)a_1}_{=\rho_2} - \tau(\rho_2 - \rho^+))dF(\varepsilon_2) \qquad (11)$$

It is easy to show that $da_1/d\tau|_r < 0$ if a larger τ compresses intertemporal resources. For this to be the case, agents have to receive transfers in period 2 and pay taxes in period 1 ($\rho^+ > \rho_2$, $\rho_1 > \rho^+$; the effect on the bankruptcy threshold obviously is absent here). Furthermore, $da_1/d\mu|_r < 0$ for strictly concave utility. The derivations are given in Appendix A.

Intuitively, if redistribution through taxes and transfers decreases intertemporal inequality, the desire to borrow or save falls. For borrowers, this lowers the welfare gains derived from the exemption x. Formally, the interval in which the bankruptcy exemption provides insurance in the second period depends positively on b_1. In the extreme case in which taxes and subsidies completely eliminate intertemporal inequality, agents do not borrow and bankruptcy exemption is useless. Thus, the intratemporal insurance motive is affected by the intertemporal smoothing motive and vice versa.

We have shown under what conditions redistributive taxation and the bankruptcy exemptions are substitutes. However, for the derivations on the intratemporal insurance motive in period 2 we have conditioned on the amount borrowed b_1 whereas for the derivations on the intertemporal smoothing motive in period 1 we have conditioned on the interest rate r_2. With both b_1 and r_2 endogenous, an interpretable analytic solution is no longer obtainable unless strong assumptions are imposed on the utility function, such as constant absolute risk aversion. We now illustrate the equilibrium in period 1 numerically for the case of constant relative risk aversion

$$u(c) = \frac{c^{1-\sigma} - 1}{1-\sigma}. \qquad (12)$$

The qualitative effect of the exemption on borrowing is then *a priori* unclear. The implied increase in interest rates might decrease credit demand. Moreover, we compute the indirect utility of a borrowing agent as a function of the policy parameters in order show how the optimal exemption level depends on redistributive taxes and transfers.

2.3 Numerical solution

We first characterize the equilibrium and the optimal exemption in period 1 before we compute the optimal exemption in period 0 to analyze the effect of persistence of shocks. We focus on borrowers because the median household in US states holds at least some debt (as we show below).

2.3.1 Equilibrium and optimal exemption in period 1

In this section we provide numerical examples that illustrate the qualitative insights obtained above. The numerical algorithm is simple: given starting values for b_1 and r_2, we use the Euler equation (10) to iterate for the optimal b_1. We then update the bankruptcy threshold ε_2^* and use the bank's arbitrage condition (5) to solve for r_2. For the new values of b_1 and r_2, we restart the algorithm until convergence.

The footnote to table 1 summarizes the parameter values of the benchmark parametrization. The parameters are chosen in order to illustrate the main qualitative insights of our simple model for borrowing agents rather than attempting to seriously calibrate the model to US data. We choose parameters such that borrowing is indeed optimal and the condition on the curvature of the utility function in Remark 3 is satisfied (the agent expects 40% higher income in the second period and is impatient). Instead the condition of decreasing hazard in Remark 1 is certainly violated, since ε_2 is assumed to be normally distributed. Nonetheless, the results of Remark 1 and 2 continue to hold in the numerical example below, making explicit that the condition of Remark 1 is sufficient but not necessary. For illustration purposes we choose an exemption level x of 90% of first-period resources which is in the range of plausible values for US states (see the data in Tables 5 and 6 and their discussion below). We assume that $\rho^+ = 0.9 = x$ so that the comparative statics for taxes τ in Remark 3 apply and set the marginal tax rate $\tau = 0.2$ which equals the mean marginal tax rate for Texas (see Table 6). We assume a rather small bankruptcy cost C of 1.5% in terms of first-period resources. Finally, the coefficient of relative risk aversion $\sigma = 2$, which is well in the range of commonly used values.

Table 1 summarizes the equilibrium values of interest for the benchmark parametrization in column (1). Columns (2)-(6) display the results when we change some of the parameters. Since the first period endowment $\omega_1 = 1$, borrowing is expressed as a fraction of it. In the benchmark case, the agent borrows an amount equivalent to 19% of these resources and defaults on the debt with a probability of 0.014, which is close to empirically observed frequencies as mentioned in the Introduction. Although the default rate is small, the interest rate on the debt is 0.032, which is 60% higher than the risk-free rate r_f. For later reference, it is useful to calculate the upper bound of the interest rate $\overline{r}_2$ for the hypothetical case in which the bank does not receive any payment in the region $\omega_2 < \omega_2^*$. In this case

$$\overline{r}_2 = \frac{F(\omega_2^*) + r_f}{1 - F(\omega_2^*)}. \tag{13}$$

In the benchmark case this upper bound is 0.034.

In column (2) of Table 1, we increase marginal taxes/transfers to $\tau = 0.25$, approximately the mean marginal tax rate of US states like Maryland or Minnesota (see Table 6 below). In our numerical example there are two effects at work. On the one hand, more redistribution through transfers/taxes decreases the amount borrowed (as pointed out in Remark 3) and thus the default probability. On the other hand, agents are taxed for some endowments where they partially default. Thus the bank appropriates less in the case of default and overall the interest rate increases slightly in this example, notwithstanding the lower frequency of default.

Column (3) shows that a fall in the exemption level to $x = 0.85$ leaves the amount borrowed nearly unchanged and does not decrease it as in the comparative statics of Remark 3. The reason is that in our numerical example, the lower exemption level decreases the probability of default by so much that the interest rate falls substantially. The resulting wealth, income and substitution effects make borrowing more attractive and cancel the direct negative effect on borrowing.

In column (4) we display the effect of lowering expected second-period income. Not surprisingly, the direct effect is that borrowing decreases as mentioned in Remark 3. This effect is strengthened by an indirect effect: the less plentiful resources in the second period imply a higher probability of default so that the interest rate rises. In column (5) we increase the cost of bankruptcy that is borne by the bank to 5% of first-period income. Quite intuitively, this increases the interest rate charged by the bank, slightly decreases borrowing and also default although the effects are quantitatively small. Finally, in column

(6) we decrease the risk aversion of the agent. Not surprisingly, this increases the amount borrowed, the probability of default and thus also the interest rate.

In Table 2 column (1), we display the optimal exemption level, at which the indirect utility of a borrower in period 1 is at its maximum. We consider the benchmark case with $\tau = 0.2$ and the case of higher marginal taxes/transfers $\tau = 0.25$. As is apparent in Table 2, column (1), higher marginal taxes/transfers decrease the optimal exemption level from $x^* = 0.871$ to $x^* = 0.845$. The implied elasticity is -0.12. This confirms the conditional results of Remarks 2 and 3 which showed qualitatively how redistribution through the tax system can lower the welfare gains derived from bankruptcy exemption intra- and intertemporally.

We now spell out expected utility *before* uncertainty is revealed in period 1. This allows us to study the importance of the persistence of shocks for the welfare gains from the exemption and its interaction with redistributive taxation.

2.3.2 The persistence of shocks and indirect utility of borrowers in period 0

Recall that there is a continuum of agents in period 0 with mass 1. Half of the agents are born with assets a_0, and half of the agents has liabilities b_0. For agents with assets in period 0, the bankruptcy exemption only becomes relevant in period 2 if they become borrowers in period 1. Since we have already analyzed policy interactions in period 1 and 2, we focus on the agents with liabilities in period 0. It is for these agents that the analysis of period 0 yields new insights.

Agents with liabilities b_0 have to repay $(1 + r_1)b_0$ in period 1. We take the size of this repayment as given. Analogous to period 2, agents default if

$$(\omega_1 - (1 + r_1)b_0)\,(1 - \tau) + \tau\rho^+ < x$$

so that the critical endowment in the first period is

$$\omega_1^* = \frac{x - \tau\rho^+}{1 - \tau} + (1 + r_1)b_0.$$

Note that our modelling structure implies that borrowers cannot commit to roll-over debt in order to avoid bankruptcy. They are always better off defaulting on their liabilities $(1+r_1)b_0$ as soon as their net resources $\widetilde{\rho}_1 < x$. This would no longer be the case if agents who default in period 1 were denied full access to the credit market in subsequent periods. In which case agents would have an option value of not declaring bankruptcy. In our model, however, there is no dynamic cost for default (besides the cost that is included in the interest rate).

From a technical point of view this assumption achieves tractability because the bankruptcy decision is essentially static and does not depend on future variables such as b_1 which in turn depends on the probability of bankruptcy in period 2.[4] We will mention below that the complementarity between bankruptcy and shock persistence is likely to be even stronger if we restrict agents' access to the credit market after default.

The bankruptcy decision in period 1 implies that a mass $(F(\omega_1^*) - F(\rho_1^*))$ of the agents with liabilities in period 0 have resources x in period 1 (before they take on new debt b_1); mass $F(\rho_1^*)$ have resources $\omega_1(1-\tau) + \tau\rho^+$; and mass $(1 - F(\omega_1^*))$ have resources $(\omega_1 - (1+r_1)b_0)(1-\tau) + \tau\rho^+$. Instead, all the savers of mass 1/2 have resources $\rho_1(\omega_1) = (\omega_1 + (1+r_f)a_0)(1-\tau) + \tau\rho^+$.

As mentioned above, we focus on agents with liabilities in period 0. Attaching the probability weights to the indirect utility in period 1 computed above, allows us to calculate the indirect utility in period 0:

$$U_0^b = E_0 u_1^b + \beta E_0 u_2^b \tag{14}$$

Before we calculate the indirect utility U_0^b, it is insightful to look at the new debt b_1, its interest rate r_2, first-period net resources $\widetilde{\rho}_1^b$ (before new debt is taken on) and present discounted utility in each of the attainable states in period 1. Expected utility U_0^b is then calculated assigning probabilities to all these states and summing up. All the parameters are as in the benchmark case if not mentioned otherwise.

The interval of the exemption level $x \in (0.5, 0.77)$ with $\rho^+ = 0.5$ is chosen so that agents borrow in period 1 both if the shocks are temporary ($\alpha = 0$); and if they are more persistent ($\alpha = 0.3$). If the exemption levels are "too" high and the realization of ε_1 is particularly bad, banks expect agents to default also in period 2 (although the possibility to default in period 1 on liabilities $(1+r_1)b_0$, already has provided some insurance for consumption). If agents are very likely to default on their debt b_1, there might be no market clearing interest rate. As equation (13) shows, the interest rate approaches infinity as agents default with probability 1. At the same time borrowing is costless for agents if they default with probability 1 so that borrowing is very desirable. Thus, no market clearing interest rate exists if exemption levels are too high and credit is rationed by lenders. Not surprisingly, the critical exemption level

[4] See Chaterjee et al. (2002) or Livchits et al. (2004) for dynamic models of bankruptcy including such costs. Empirical evidence by Musto (1999) or Staten (1993) suggests, however, that a substantial fraction of agents has access to credit in the year immediately after bankruptcy although the stored bankruptcy information seems to constrain borrowing behavior to some extent. Note also that we do not allow lenders to write multi-period contracts.

above which agents no longer have access to the credit market in period 1 is smaller as bad shocks become more persistent and larger as good shocks become more persistent (in period 1 both parties know the realization ω_1). Persistent shocks give banks additional information about future repayment behavior which is predictably better if ε_1 is a good draw and worse if it is a bad one.

Figures 2 and 3 plot net resources $\widetilde{\rho}_1^b$ (before taking on new debt b_1), debt b_1 and its interest rate r_2, and present discounted utility in period 1 for ± 3.1 standard deviations of ε_1. The graphs are in (ε_1, x)-space for different levels of persistence $\alpha = 0$ and $\alpha = 0.3$. Total liabilities $(1 + r_1)b_0$ amount to 0.25, a quarter of expected first-period income. This obviously makes bankruptcy very attractive and is useful for illustration purposes. Utility in period 1 and net resources have a similar shape since the bankruptcy exemption implies almost no default in period 2 if $x \in (0.5, 0.77)$ (see the previous section). This allows us to usefully isolate the effect of bankruptcy in period 1 before we compute the optimal bankruptcy exemption for an unrestricted range of x.

In the figures, net resources in period 1 have the familiar shape as a function of ε_1 (recall Figure 1). Resources are flat at x when the exemption fully insures the agent. Such insurance occurs for a larger region of shocks if the bankruptcy exemption is more generous. Net resources (before taking on new debt) are obviously independent of the persistence of the shock. Persistence, however, matters for the interest rate r_2, the optimal amount of debt b_1, and also utility. Banks take into account that a bad and persistent shock implies a larger probability of default in period 2. Thus, as can be seen in the figures, when a bad shock of given size is more persistent, then the interest rate r_2 is larger (this effect is stronger at higher exemption levels) which makes it more costly for agents to access the credit market in period 1. However, increasing the persistence of bad shocks also decreases the agents' desire to borrow: rather than borrowing to smooth consumption agents adjust consumption downwards. Of course, the reverse reasoning holds if good shocks are more persistent. As can be seen in the figures, agents borrow more if good shocks are more persistent (they are impatient and borrow against their higher expected future income). The figures also make clear that the relationship between borrowing and the exemption is non-monotonic.

As well as the direct positive effect of the exemption on borrowing (given resources $\widetilde{\rho}_1^b$ and the interest rate r_2), and the effect through the interest rate r_2, the exemption also increases first-period resources $\widetilde{\rho}_1^b$ since agents can default on their liabilities from period 0. This decreases the borrowing motive as can be seen in the figures (see also the discussion of Remark 3). Hence, the bankruptcy exemption shelters consumption against bad draws in the first period but dynamically this can imply that the bankruptcy exemption is less attractive in period 2 if agents borrow less in period 1 (e.g. b_1 decreases). Having more resources in the first period (a larger $\widetilde{\rho}_1^b$) reduces the smoothing motive; and a larger exemption level x makes new debt more expensive (e.g. r_2 increases). Thus, the overall effect on first period utility, u_1^b, of the exemption and of the persistence of shocks, depends on which of these effects dominates.

In our numerical example, more persistence makes utility a steeper function of draws ε_1 which is rather obvious. More interestingly, more persistence also makes utility a steeper function of the exemption level x, in the region where bankruptcy matters. On the one hand, insurance in period 1 through the bankruptcy exemption is more valuable in marginal-utility terms if bad shocks are persistent and cannot be smoothed out by borrowing against future higher expected income. This effect is well-known (see for example Athreya and Simpson, 2003). On the other hand, persistent shocks imply less debt b_1 in bad states of the world and thus make bankruptcy less attractive in period 2. In our example the first effect outweighs the second. However, at this point it is important to recall that our plots are only for exemption levels for which higher exemption does not imply credit rationing. If the higher exemption implies credit rationing this certainly makes agents worse off. This will be important below to understand how the optimal exemption level changes with the persistence of shocks.

After having provided an example of how indirect utility in period 1 depends on ε_1, x, and α, we now compute the indirect utility U_0^b and the implied optimal exemption level to illustrate how the persistence of the shock in period 1 affects the trade-off between the two policies: how does redistributive taxation change the effect of persistence on the welfare gains from the bankruptcy exemption? Columns (2) and (3) in Table 2 display the optimal exemption levels for a borrower in period 0 if shocks are purely transitory ($\alpha = 0$) and if shocks are persistent ($\alpha = 0.3$). Not surprisingly, the optimal exemption levels for the case of purely transitory shocks are nearly the same in period 0 as in period 1. The small differences result from the initial liabilities in period 0 which are slightly higher than the amount borrowed in period 1 and from the change of the parameter $\rho^+ = 0.5$ so that agents are taxed for a larger range of endowments. Both changes imply a slightly larger optimal bankruptcy exemption. The implied elasticity of a higher marginal tax/transfers rate remains unchanged up to the second digit.

If shocks are more persistent, however, the optimal exemption level falls. This results from the fact that exemption levels imply more credit rationing if shocks are more persistent. The supply-side effect of more persistent shocks outweighs the demand-side effect, which implies that bankruptcy is more attractive if agents are hit by more persistent shocks (for a given level of borrowing). Interestingly, higher taxes/transfers have a smaller effect on the optimal exemption if shocks are more persistent. The implied elasticity is -0.09. Indeed, the optimal exemptions for $\tau = 0.25$ reveal that redistributive transfers reduce the difference in marginal utility after temporary and permanent shocks so that persistence matters relatively less for the bankruptcy exemption if taxes and transfers are more important.

As mentioned above we have abstracted from irreversibility in the bankruptcy decision. Such irreversibility could arise through exclusion from the credit market using information about default that is circulated by credit bureaus. Such dynamic costs imply an option value of delaying bankruptcy and are likely to matter more for the bankruptcy decision if shocks are temporary rather than permanent: access to credit is more important to smooth consumption if shocks are temporary. Thus bankruptcy and the implied exclusion from future credit should be a more attractive option in the presence of persistent shocks. Furthermore, we have implicitly assumed that the government budget constraint is balanced. We do not explicitly check this in our computations because it does not add any new qualitative insight (the distribution of initial assets could be assumed so that the constraint is satisfied).

Finally, we do not explicitly model how the interaction of the two policies analyzed above translate into policy choices. This would be straightforward if we modelled policy choices in a probabilistic voting model in which agents decide about policies once and for all in period 0 (however, one should be careful with normative conclusions, since we treat the respective deadweight losses of the two policies as exogenous in our model). If agents with liabilities in period 0 have the full weight in such a model, all of the insights above for indirect utility U_0^b immediately translate into a model of policy choice. This is not unrealistic since the median household in the US states holds unsecured debt (see the empirical part below for further details). We could also allow agents with positive assets to have a positive weight in such a political process. But since the bankruptcy exemptions matter for agents with positive assets to the extent that these agents become borrowers in the future, this would not change the qualitative insights for the channels we have investigated. In this case, however, the persistence of shocks would also affect the likelihood of borrowers becoming savers and vice versa. Such a more comprehensive analysis is certainly interesting but we leave it for future research.

Ultimately, it is an empirical question whether redistributive taxation and bankruptcy exemption are substitutes and if so whether their effect on the inter- and intratemporal insurance motives highlighted by our model can explain why.

3 Data

We have provided a model that has described some channels of interaction between redistributive taxation and the level of any bankruptcy exemption. We have emphasized the importance of the probability distribution and the persistence of the shocks, for the sign and size of the policy interaction. We now provide some empirical evidence using interesting variation on the two policies across US states in the period 1980-99, but first we discuss the data sources and the econometric specification. We use micro data to construct a sample of state-year cells for the period 1980-99 (except in our debt equations where we use the household level data). We only mention the most important issues concerning our empirical application and refer to Appendix B for more detailed information.

We use the Consumer Expenditure Survey (CEX) to construct a measure of non-durable consumption and debt for each household. Our measure of unsecured debt uses separate questions that were asked about debts held in revolving credit accounts (including store, gasoline, and general purpose credit cards), in installment credit accounts, credit at banks or savings and loan companies, in credit unions, at finance companies, unpaid medical bills, and other credit sources. Our measure also includes negative balances held in checking or brokerage accounts. We sum these different sources of unsecured credit to construct total debt for each household. Excluded from the total are mortgage, and other secured debts so that the debts analyzed differ from those in Gropp et al. (1997). This is important because the impact of bankruptcy exemptions on secured and unsecured debt ought to be very different (see Hynes and Berkowitz, 1998). While mortgage (and other secured) debt is also likely to be important for the household, the creditor has an additional claim to such assets and can always recover the house (or other security) if the debtor defaults. The housing, or other exemption will not affect the creditors rights in this case, and hence it does not make sense to include such debts in the analysis. Consumption and debt have been deflated by a consumer price index and are in real 1983 dollars. The mean level of debt in the survey is $2,151 (the median is $331, while the 75th percentile is $2,211). Around 60 percent of people hold at least some unsecured debt, and this proportion is similar across all states (see the last column in table 6). Thus the median household in each state holds at least some unsecured debt.

Information on household level income and transfers is obtained from the March supplement of the Current Population Survey (CPS). To measure the level of income taxes that each household pays, we exploit the TAXSIM 4.0 program developed by Freenberg (see Freenberg and Coutts, 1993, for details) that is available from the NBER. We construct three alternative measures of the tax system which account for both federal and state level legislation on taxes and transfers: the mean marginal tax rate, an 'income-compression measure' that compares the inequality of gross with net income, and a poverty index - the proportion of households whose after-tax and transfer income was below half the median. Finally, we construct a measure for the bankruptcy exemption using information contained in the bankruptcy acts passed at the federal and state level.

When constructing year-state cells we restrict the sample to those households for whom complete state information is available and where the head is aged between 30 to 60. Moreover, farming households are excluded since they have their own separate chapter of the bankruptcy code. As frequently done in the literature, we also exclude the self-employed since differences between business and personal income are hard to distinguish. Furthermore, we are interested in consumer's risk and not entrepreneurial risk and self-employed households have motivations for borrowing other than to smooth consumption. For confidentiality reasons, state information is sometimes suppressed in the survey and in some states relatively few households are sampled. Hence, to ensure that there are enough observations used to construct each cell, our sample only contains households resident in the 18 largest US states.

3.1 Measuring redistribution of the tax-transfer system

Constructing a measure of the tax system in each state is not trivial and we need to address a number of problems. US households are subject to taxes levied at the federal and state level, by county administrations, and by schoolboards. These taxes include income taxes, sales taxes, property taxes and duty. We concentrate on income taxes which are raised at both the federal and state level, but we do not include property and sales taxes in our measures of the tax system since they are largely levied at the county, schoolboard and city level which we cannot identify in our data. Moreover, sales taxes are paid at the place of sale and not that of residence which makes it extremely difficult to devise a measure of sales taxes levied on each household within a state if cross-border shopping takes place. However, we do not believe that excluding sales taxes is problematic since the expenditures recorded in the CEX exclude sales taxes, making the consumption measure comparable across states.

Taxes vary considerably across states and over time. As an example, columns two, three and four of Table 6 display the 1998 tax rates applicable in some of the largest US states. Over the entire US, eight states, including Texas and Florida in the table, do not levy any state income tax. The other states have a variety of income tax brackets that differ in their progressivity. In most states the marginal tax rate increases with income and in many states there are a variety of tax allowances (which will depend on such things as whether the taxpayer has a spouse or other dependents). For example, in California, the lowest tax bracket is at one percent, and the highest is at 9.3 percent. In contrast, some states like Pennsylvania levy a flat-rate income tax of 2.8 percent and there is no tax-exempt income. Other states allow some income to be exempt from tax and these tax exemptions can sometimes be quite large. For example, Minnesota allows the first $2,900 to be exempt for single filers. A few states, such as California, have a tax credit rather than a level of exempt income. For further information on the federal tax schedule and changes over time we refer to Appendix B.

To construct the level of income taxes paid by each household, we exploit the TAXSIM 4.0 program. This program uses a variety of household variables, including a husband's and wife's earnings, interest, dividends and other income, and information about the household's characteristics (such as the number of dependent children) and other deductibles (like property costs) as well as the year and state of residence as inputs, to calculate both the state and the federal tax bracket, tax liability, and marginal tax rate for each household in the sample, while explicitly controlling for a variety of allowances to which the household is entitled. We use the CPS data to contruct each household's tax liability.

Having constructed these tax liabilities, the problem is to summarize the tax system in each state in each year. One commonly used measure is the mean marginal tax rate (accounting for both federal and state income taxes). Table 6 shows how the mean marginal tax rates vary across some of the largest states. Texas and Florida have the lowest tax rates of 19 percent since these states have no state income tax and only pay federal income tax. Tax rates are higher in Maryland and Minnesota, at around 25 percent, reflecting the higher level of the state-income tax.

However, the mean marginal tax rate is a rather unattractive measure since it does not allow us to capture the substantial heterogeneity in marginal tax rates across agents each year even in the same state. For example, a mean marginal tax rate of 20 percent could be due to a uniform marginal tax rate of 20 per cent, or to the top 20 percent of the population having a rate of 100 percent and the rest of the population having a rate of zero, or the bottom 20 percent having a 100 percent tax rate and the top 80 percent paying nothing. These three tax schedules have substantially different implications for redistribution. Moreover, the mean marginal tax rate ignores the level of transfers that households receive. Thus, we construct an alternative and more direct measure of how much the tax system redistributes income, the 'income-compression measure':

$$1 - \frac{sd_{st}\left(\text{income}_{ist} - \text{tax liability}_{ist} + \text{transfers}_{ist}\right)}{sd_{st}(\text{income}_{ist})} \tag{15}$$

where i denotes the household. This 'income-compression measure' compares inequality in net and gross income for each state s and year t. If inequality in net and gross income are the same (for example if all households paid the same lump-sum tax), the measure takes the value of zero. If instead there is no inequality in net income but some inequality in gross income, the measure takes the value of one. Thus, increasing the amount of redistribution through taxes and transfers decreases inequality in net income compared with gross income, and increases the 'income-compression measure' of the tax system. Moreover, if all households faced the same marginal tax rate and there were no allowances, the 'income-compression measure' would be equal to the marginal tax rate (and also the average tax rate). However, given the substantial heterogeneity in marginal tax rates and transfers across households, we prefer this 'income-compression measure' to the mean marginal tax rate (nonetheless we will report results for both measures below, as well as for the poverty measure we described earlier). Table 6 shows that Texas and Florida again have the lowest level of redistribution using the new measure while the index is now highest in New York, Minnesota and California. However, the ordering of states is similar across the two measures (the correlation coefficient is 0.78).

We also construct a third measure of the tax system, which is one minus the proportion of households whose after tax and transfer income is below half median income in the respective state and time period. We call this the (inverse) 'poverty index' (and the correlation coefficient with the mean marginal tax rate is 0.65).

3.2 Bankruptcy regulation

Within the United States, bankruptcy is regulated by the Federal Bankruptcy Act of 1978 which contains two chapters specific to non-farming households. Individuals could choose to file for personal bankruptcy under either Chapter 7 or under Chapter 13 if this was not a 'substantially abuse' of the bankruptcy regulations. The aim of the act was to allow households to discharge their debts and make a 'fresh start'. But in contrast to other legal jurisdictions, there was no regard to whether the household was genuinely unable to pay or whether repayment would result in substantial hardship. However, debt arising from court orders (such as alimony and child support but not tort judgements), taxes or student loans could not be evaded through bankruptcy. Nor could the household avoid surrendering assets if the debt was secured.

Under chapter 7 of the act, the debtor has all his debts expunged but must surrender all his assets except those (deemed by the court) as necessary for him to make his 'fresh start'. This necessary amount is the 'exemption', with assets exceeding this value being sold and the excess amount used to satisfy the debt. Cash (up to the value of the exemption) is retained by the debtor although in some cases the courts insisted that the money had to be reinvested in an exempt asset within a certain time period. Under Chapter 13, the debtor agrees to a repayment schedule for part or all of the debt, and can keep his assets. The debtor could choose to file under either chapter but many courts preferred the debtor to file under chapter 13 (however, enforcing only nominal repayment schedules). Around 70 percent of personal bankruptcy cases resulted in a filing for Chapter 7 with the remainder of filings under Chapter 13. Crucially, the debtor could choose to file under either chapter 7 or chapter 13, and thus could never be made to pay more than could be enforced under chapter 7 bankruptcy. Thus the exemptions under chapter 7 placed an upper limit on the amount of unsecured debt that could be recovered through the courts by creditors. Our empirical analysis exploits this crucial insight.

The federal exemption levels have been revised several times since 1978 and from April 1998 the bankruptcy act was emended to allow the nominal amounts to be adjusted in line with the retail price index every three years. The relevant federal exemption levels are shown in Table 5.[5] The 1978 Act allowed the house or homestead to be exempt up to the value of \$7,500 while other exempt assets included a car of \$1,200, household goods up to \$200 for each item, jewelry up to \$500, other property up to \$400 (and any unused homestead exemption), and 'tools of trade' up to \$750. This last item refers to work material or assets needed in order to practise professionally (although some, but not all jurisdictions allowed transport to and from work to be included in this category). Throughout the analysis, we will exclude the 'tools-of-trade' exemption since it applies mostly to self-employed households which are excluded from our sample (although including it in our analysis does not substantively change the results).

Table 5 also shows that the federal exemption levels have been revised periodically. The 1984 reform introduced an upper limit on the total value of exempt household goods and reduced the amount of unused homestead exemption that could be claimed for other goods.

[5]The latest legislation on bankruptcy was passed in 2003, but this year lies outside our sample period and hence it will not be discussed.

The revision in 1994 doubled the dollar amounts in each category, while from 1998 the dollar amounts have been adjusted for inflation every three years. Finally, married households who jointly filed for bankruptcy were allowed to claim the exempt amount in each category for each person.

Bankruptcy had traditionally been regulated by the individual states and the Federal Bankruptcy Act in 1978 continued to let states set their own level of exemptions (they were allowed to specify the type and value of goods that are exempt under state law) and even to disallow the federal exemption levels. Similarly to the federal exemptions, most states have specified a variety of goods that are exempt from seizure or forced sale and, unless state law prohibited this, the debtor could choose between the federal and state exemptions (and naturally would choose the larger of the two exemptions).[6] Legislation regarding other aspects of the enforcement of bankruptcy law were uniform across states.

Table 6 displays some of the differences in exemption levels across states for single filers in 1984 and in 1998. Many states allowed larger exemptions for couples, for older households, and for households with dependents. The table shows that the homestead was fully exempt from seizure in Florida and Texas (although there was an acreage limit). Moreover, in Texas in 1998, $30,000 worth of other assets were exempt, with the amount being doubled for couples filing jointly. In Florida in contrast, the corresponding exemption was up to $1,000 worth of personal property and a car worth up to $1,000. Furthermore, households in Florida were not allowed to claim the federal exemptions. Another example is Minnesota, that allowed the homestead to be fully exempt in 1984 but later changed this to a maximum value of $200,000. The other exemptions increased from $6,500 to $11,050 during the same period where the exemption level was adjusted in line with the retail price index every two years. Other states, such as Pennsylvania, set the exemption level much lower. In Pennsylvania, only $300 of property was exempt from seizure although clothing was also exempt. However, Pennsylvania allowed households to claim the federal exemptions and obviously households would prefer to do so in this state. Maryland, however, both set a low bankruptcy exemption (the housing exemption was $2,500 and the other exemptions were $3,500) and did not allow the federal exemption to be claimed. Indeed, Maryland had actually reduced the housing exemption in 1983 from $3,500.

The courts have also allowed debtors substantial room for manoeuvre in fully exploiting all the exemptions available. In many cases courts have allowed the debtor to rearrange his

[6]Information on the state bankruptcy exemptions was constructed from the Annotated State codes and from primary legislation.

portfolio of assets prior to default and substitute exempt assets for non-exempt assets (some limit is placed on the ability to rearrange assets by 'abuse/fraud' provisions). Since there is considerable scope for substituting between assets when filing for bankruptcy, we have added the exemptions to construct a total nominal value of the exemption for each household in each state and year. Since households were only allowed to claim the housing exemption if they owned their own house (either outright or through a mortgage), we have added the homestead exemption to the exemption on all other assets only if households owned their home. A more detailed assessment of the household's asset position is not possible because of limited information in the CEX. If no specific upper limit of exemption was defined for a category of goods (for instance Pennsylvania allowed "all necessary wearing apparel"), we assigned the maximum exemption level for that good category in those jurisdictions that had a limit (see Grant, 2001 for further details). For the homestead exemption instead, we include a dummy in the regression if no upper limit for this item was specified. In calculating the exemption level for each household, we considered the household's age, the number of dependents and whether the household was headed by a couple. In states in which households are allowed to claim the federal exemption and this exemption is higher than the state exemption, we use the federal exemption to construct our measure. Finally, we normalize the exemptions by dividing the exemption by average income in each state-year cell. This normalization will better measure how generous the exemptions are as a proportion of income.

Our merged data set contains unsecured debt, consumption, consumption growth, and exemption levels by household for the 18 states in the period 1980-99. We then added the state year data on our three measures of the tax system to this data. For our debt regressions we use the household data, but for the other regressions we aggregate the data into 348 state-year cells (we included all states with an average cell-size of at least 60 - but some states are not identified in the first year or two of the CEX). The sample period for unsecured debt is shorter since detailed information on debt is only available from 1988 onwards. For each state-year cell we construct the standard deviation of log consumption and of consumption growth. The latter measure is an indicator for consumption insurance. The standard deviation of consumption measures the cross-sectional level of inequality. This is a rather imperfect way to proxy consumption insurance because it does not distinguish between *ex-ante* and *ex-post* inequality. Thus, we also exploit the implications of consumption insurance for inequality in consumption growth.

If markets are complete then the cross-sectional distribution of inequality should not change over time for a group with fixed membership. Deaton and Paxson (1994) test, and reject, this implication of complete markets. However, a useful corollary is that if markets are incomplete then this cross-sectional measure should increase. Moreover, if the shocks are the same across groups, the rate at which this inequality changes over time should be larger for those groups in which there is less risk sharing. While Deaton and Paxson looked at the change in the cross-section of consumption inequality, the same implications arise for the standard deviation of consumption growth. That is, if markets are complete, consumption should increase for all households by the same amount. Hence if consumption is growing by different amounts for different households (in which case the variance of consumption growth is positive), then we can again reject complete insurance and moreover, we know that markets provide less insurance if the variance of consumption growth is larger. We will estimate the regressions using this measure by taking the difference between the household's level of log-consumption in the fifth interview from the level of log-consumption in the second interview (recall that the household is interviewed five times in successive quarters in the CEX survey, but no information is released from the first interview).

4 Econometric specification

We will estimate three different sets of equations with different dependent variables but otherwise similar controls. The dependent variables are unsecured household debt, the standard deviation of consumption and of consumption growth, and a measure for redistribution through taxes and transfers. The regressions for household debt shall give some insight on the effect of the two policies on the intertemporal smoothing motive. The regressions with proxies for consumption insurance show whether and how both policies matter for insuring consumption. Finally, we directly look at correlations between our measure for tax/transfer redistribution and exemption levels in order to find out whether there is some suggestive evidence that these two policies are substitutes.

Of course, these specifications do not exploit all the structure laid out in the theoretical part. But the limited number of observations (we only have 348 state-year cells) make it impossible to test the predictions of the model more thoroughly. Thus, the reduced-form regressions only allow us to investigate whether the data are broadly consistent with our theoretical hypotheses.

Except for the last set of regressions in which the measure of redistribution is the dependent variable, the regressions take the form:

$$y_{st} = \beta_0 + \beta_1 \tau_{st} + \beta_2 x_{st} + f_s + \varepsilon_{st} \tag{16}$$

where as before s is the state, t is the time period, τ is the measure for redistribution through the tax system, x is the bankruptcy exemption level and y_{st} denotes the respective dependent variable. The error is composed of a state fixed effect f_s and an idiosyncratic component ε_{st}. The state fixed affect will capture any constant unobserved heterogeneity across states that is not accounted for by the policy variables. The state fixed effects are estimated by including additional state dummies in the regression. Consistent estimation of $\beta = [\beta_0\ \beta_1\ \beta_2]'$ thus requires a large number of time periods.

Concerning the problem of measurement error, we can take advantage of using two different data sources. For example, if we regress the standard deviation of consumption on a measure of redistribution, the measure of redistribution is constructed using the CPS while consumption is taken from the CEX. This has a number of advantages. Since the CPS is a larger survey than the CEX, cell averages are measured more precisely so that the small sample bias is reduced. Moreover, if both measures had been taken from the same sample, measurement error of the dependent variable and the regressor would be correlated. This would not only bias the estimates but the bias in general would have an ambiguous sign. Constructing the cell averages using different data sets circumvents this problem.

4.1 Instrumental Variables

Another estimation issue of equation (16) is that the policy variables possibly change at the same time as the dependent variables, as is well known in the literature (see for instance Besley and Case, 2000, and in particular Berglöf and Rosenthal, 2000, and Nunez and Rosenthal, 2002, for bankruptcy legislation). For example, if a state is hit by a productivity shock, this is likely to affect the state's budget (and hence tax requirements) but also gross income of the households in that state and their level of consumption. Thus, we need to use instruments that can predict the policy variables τ and x but do not affect the dependent variable. We experiment with two possible instrument sets. On the one hand we use lagged values of the redistribution measures and the exemption level. On the other hand, we also experiment with a set of political variables that capture tastes rather than economic fundamentals, and the efficiency of the local tax system. The instrument set includes the political affiliation of the state governor and the state legislature, the relative proportion of voters in each state for the democratic rather than the republican party candidate in the presidential elections (all lagged) and two measures of how effective the state is at raising tax revenue: the tax fiscal capacity of the state in each period, and the tax intensity or effort in each period. For the years up to 1991 the data are available from ACIR (Advisory Commission on Intergovernmental Relations, 1993), while subsequent data are taken from Tannenwald (2002) although it was necessary to linearly interpolate the two series for some years. A full discussion of these variables is contained in these two references. One problem with this instrument is that the data are not available for the latest years in our survey.

The political variables make useful instruments because they reflect tastes for taxes, redistribution and exemptions that are not related to current changes in the economy (since we lag the political variables by one period). The ACIR index is even more natural as an instrument as it measures how efficient the state is at raising tax revenue. States that are more efficient, in the sense that a given marginal tax rate raises a higher proportion of income from households (accounting for the cost of raising the revenue, and the amount of revenue that is raised) will have a larger tax-efficiency measure using the ACIR index. Alternatively, to raise a fixed proportion of income takes more effort by the local tax authorities. A state which is less efficient at raising tax revenue is more likely to resort to a generous bankruptcy exemption rather than attempt to increase redistribution through the tax and benefit system.

5 Results

The results are contained in Tables 7 to 9. Table 7 contains regression results on the relationship between both policies and the level of unsecured household debt. Table 8 displays results on how both taxes and the exemptions are associated with the standard deviation of consumption and consumption growth. Finally, Table 9 directly looks at the correlation between the level of the bankruptcy exemptions and the tax and benefit system.

5.1 Redistribution, the exemption level and household debt

Table 7 shows the estimates the effect of the tax system and of the bankruptcy exemptions on the level of unsecured debt. The regression uses household level data in 1983 prices, with unsecured debt and the exemption level in logs, or rather as the $\log(1+b)$ and $\log(1+x)$. We also include a full set of household characteristics which are reported in the table to control for observable heterogeneity that relates to permanent income and life-cycle circumstances among other things, and a set of state and time dummies.[7] The first, fourth and seventh column uses the income compression measure of the tax system, our preferred measure, while the second, fifth and eighth column uses the mean marginal tax rate and the third, sixth and ninth uses the poverty measure. All other regressors are identical across the reported regressions.

The results of the tobit regression (the first three columns) show that the effect of the household characteristics is almost exactly the same regardless of which tax measure is used in the regression. Of the characteristics, we find that younger households have more debt (those around 30) and that debts decline steadily with age. This is consistent with standard lifecycle models of consumer behavior in which income increases over the working life. The table also shows that better educated households have more debt. This seems reasonable since these households have higher levels of permanent income relative to current income which they might want to bring forward at the early stage of their life-cycle. However households where the head has completed a full college degree has less debt than if the head has only had some college education. Black and female households have lower levels of unsecured debt, as do married couples. Family size increases the level of debt, but family size squared reduces it. A similar pattern is apparent for income, and our results show that debts increase with income over the range of households in our survey.

Of course, the main focus of the analysis is the effect of the bankruptcy exemption and the tax system. Each regression includes the exemption level, included separately for homeowners and non-homeowners, a dummy for the unlimited homestead exemption for homeowners. Each regression, in turn, uses a different measure of the tax system. Consistent with the non-linear effect of the exemption on borrowing in our model, there is now clear pattern in the econometric results.

The bankruptcy exemption enters negatively for renters and positively for homeowners. In both cases the estimated effect is significant if we look at the tobit regressions: renters hold 6 percent less debt while homeowners hold 1.1 percent more debt if the bankruptcy exemption increases by 10 percent. The dummy for the unlimited homestead exemption is also positive and significant in the regression. The implied effect is that households who own their own home and live in a state in which the home is fully exempt from seizure if they declare bankruptcy have 36 percent more debt. However, note that if we control for state fixed effects, as is done in the regression, the coefficient of the dummy for unlimited homestead

[7] We include an age polynomial and a set of time dummies which precludes using dummies for year of birth since they are not linearly independent. However, the interpretation of these coefficents is not central to the analysis in this paper, hence we will not comment further on this.

exemption is identified only from states in which this unlimited homestead exemption level changes over time. This only happened once, for Minnesota, which abolished the unlimited homestead exemption in 1993 and replaced it with a homestead exemption of $200,000. Hence, the coefficient of the dummy for unlimited homestead exemption is not well identified. Given the poor identification, we will rarely comment on the estimated effect of this variable in the following discussion of the results.

The results on redistributive taxes and transfers are rather mixed. In the first column we use the income compression measure, and the estimated tax effect is negative. Although this is consistent with Remark 3 and our numerical results the coefficient is not significant. If taxes and transfers reduce intertemporal inequality, then increasing the amount of redistribution of the tax system should lower the need to borrow and save to smooth consumption over time. The second and third column use the mean marginal tax rate and the poverty index respectively. Again, the estimated effect of the tax system does not enter significantly and even has a positive sign in column (2).

However, it is well known that the tobit regression imposes that the error distribution is normal. Hence in columns (4)-(6) we repeat the regression but use the censored least absolute deviation (CLAD) regression proposed by Powell (1984). This semi-parametric estimator does not impose any assumptions on the distribution of the error term in the latent regression, and in constrast to the tobit equation consistently estimates the median rather than the mean.[8] The reported results are broadly similar overall to the results of the tobit regression, but there are some differences. As before the tax system does not have a significant effect on the level of debt in the regressions, and the sign of the effect differs according to which measure of the tax system is used. The estimated effect of the bankruptcy exemption for renters is now much smaller, and is no longer significant. The size of the effect is around one third of the previous estimate, but remains negative. However, the estimated effect on those households who own their house is nearly double the previous estimate and remains significant at the 5 percent level. The effect of the house being fully exempt regardless of its value, the unlimited homstead dummy, is also estimated to be slightly larger in the CLAD regressions, and is again significant at the 5 percent level.

Finally, in columns (6)-(9) we report results for the CLAD regressions if we instrument the tax/transfer measures with our set of political and tax-efficiency variables. Qualitatively the results remain by-and-large the same but the size of some the coefficients and standard

[8]The true sample errors of the estimates depend on the density of the errors at the median, which is not known, hence hence we calculated the standard errors of the estimated coefficients by bootstrapping using 200 draws.

errors changes substantially. The rank test for weakness of instruments in the first stage was passed for conventional significance levels.

5.2 Redistribution, the exemption level and consumption insurance

Table 8 reports results for consumption inequality for our three different measures of the tax system, including state dummies to control for fixed differences across the states. Column (1), (5) and (9) use the standard deviation of log consumption. In these regressions, market completeness would imply that neither taxes nor the bankruptcy exemptions will be significant. Hence if they are significant we will reject full insurance, as in the Deaton and Paxson test we discussed earlier. Column (1) uses our preferred measure of the tax system, the income compression measure. In this regression both the tax system and the bankruptcy exemptions enter negatively, but while the bankruptcy exemption is significant at the 10 percent level, the tax system is not significant. Column (5) uses the mean marginal tax rate as the measure of the tax system and in this regression the tax system and the bankruptcy exemption are both significant at the 10 percent level. Column (9) uses the proportion of households that have income below half of the median post-tax income. Again both redistribution through the tax system and the bankruptcy exemption enter negatively and significant in the regression (after controlling for state fixed effects). Indeed, the coefficients suggest that the redistributive measure of taxes can account for one third of the differences in within state consumption inequality of the states in our sample. This effect is large, but Grant et al. (2003) found similarly large effects. Moreover, the coefficient on the bankruptcy exemption implies that reducing the taxes by 9 percentage points (roughly the difference between New York and Texas) has a similar effect on inequality as increasing the exemption by $20,000 in 1984 prices. In other words, Texas and New York should not have dramatically different levels of inequality as a result of their very different choices between redistribution through the tax system and their bankruptcy exemptions (recall table 6) since the generous exemptions in Texas will mitigate the fact that there is no state income tax.

However, as we stated, the inequality in consumption growth better measures the pure insurance effect of both policies, and this insurance effect is fundamentally what is of interest to us here. The rest of the table reports results for this regression, including state fixed effects. In the OLS regression taxes are always significant regardless of which measure of the tax system is used in the regression. However, only in column (6) are the bankruptcy exemptions significant, although in columns (2) and (10) the exemptions are only marginally insignificant at the 10 percent level. However, a concern with these regressions is that taxes and income or consumption shocks may be co-determined. Given the fairly short time frames in which taxes are decided, they might respond to changes in business conditions in the state. However, bankruptcy exemptions are more difficult to change. Hence we have attempted to instrument the tax system using their lags, and using a set of what we call political variables which are discussed above. In all cases the rank test for the significance of the instruments in the first-stage regression is passed for conventional significance levels. Instrumenting taxes with the tax system lagged twice gives very similar results and again, while the tax system is always significant, bankruptcy exemptions are only significant in column (7). Lastly, we instrumented using the political variables we discussed earlier, finding that this time both taxes and the bankruptcy exemptions entered the regression significantly for either the mean marginal tax rate or the income compression measure of taxes. Moreover, when we instrumented using these variables we could not reject the over-identifying restrictions (the Sargan test was passed). Both policies have an effect of similar size, with the type of differences across the US states implying around a half standard deviation reduction in inequality growth rates when moving from a generous state to an ungenerous state.

5.3 Redistribution and bankruptcy exemption

We have found mixed evidence on how redistribution is associated with unsecured debt but both policies seem to provide some consumption insurance, especially if we instrument using the set of political variables. This suggests that both redistributive tax-transfer schemes and bankruptcy exemption might be substitutes according to the hypotheses put forward by the model. In Table 9 we provide more direct evidence for this hypothesis looking at the correlation between these two policies in a controlled regression framework. In column (1) of Table 9 we regress the income-compression measure on the exemption level including a set of state dummies. We find that the coefficient of the exemption level is negative and significant at the 5% level when we use either the income compression measure or the mean marginal tax rate. The coefficient implies a rather small effect, equivalent to the higher exemption levels in Texas reducing income taxes by only one percent.

We also tried instrumenting the exemption level with their lags, and using the set of political variables which we described earlier, which gives similar results (see column (2)). In the last case the coefficient is significant at the 1 percent level using either the mean marginal tax rate of or the income compression level. The estimated coefficient is 10 times as large when we use the political variables in column (3), the implied elasticity of the exemption with respect to taxes (calculated at the mean) is roughly -0.05 when the income compression measure is used. This number is of the same order of magnitude as for simulation exercise in section 2.3 above. Moreover, the estimated coefficient would imply that roughly all the difference in tax rates between Texas and New York can be explained by the differences in the exemption level.

6 Conclusion

We have shown in a simple modelling framework that bankruptcy regulation and redistributive taxation interact in non-trivial ways. Both policies interact through the intratemporal insurance and intertemporal smoothing motive. We provide sufficient conditions under which both policies are substitutes and search for empirical support using data on US states in the period 1980-99. Consistent with our theoretical perspective, we find (i) that both redistribution and bankruptcy exemption are correlated negatively with inequality of consumption and consumption growth; and (ii) that the extent of redistribution and the size of the bankruptcy exemption level are negatively correlated in our sample; (iii) at least for homeowners, that the exemptions are associated with higher unsecured household debt.

These results suggest that the variation of the two policies in the US states can be rationalized within a simple economic model. Although normative conclusions cannot be drawn with the current empirical evidence, the results of the regressions with instrumental variables suggest that there possibly is an interesting policy trade-off in that bankruptcy exemption is less effective in increasing welfare if redistributive taxation is already quite pronounced.

Appendices

Appendix A: Derivations and proofs for the model

Derivation of $dr_2/dx|_{b_1}$
Total differentiating equation (5), plugging in ω_2^* and rearranging, we get

$$\begin{aligned}
&\left((1-F(\omega_2^*))\left(b_1+(1+r_2)\frac{\partial b_1}{\partial r_2}\right)-C\frac{\partial \omega_2^*}{\partial r_2}f(\omega_2^*)-\frac{\partial b_1}{\partial r_2}(1+r_f)\right)dr_2 \\
&+\left((1-F(\omega_2^*))\left(\frac{\partial b_1}{\partial x}\right)-\left(F(\omega_2^*)-F(\rho_2^*+\frac{C}{1-\tau})\right)-C\frac{\partial \omega_2^*}{\partial x}f(\omega_2^*)-\frac{\partial b_1}{\partial x}(1+r_f)\right)dx \\
= \;& 0
\end{aligned}$$

Noting that

$$\frac{\partial \omega_2^*}{\partial x}=1/(1-\tau)+(1+r_2)\frac{\partial b_1}{\partial x}$$

and

$$\frac{\partial \omega_2^*}{\partial r_2}=b_1+(1+r_2)\frac{\partial b_1}{\partial r_2},$$

we find the expression $dr_2/dx|_{b_1}$ displayed in the text.

Proof of Remark 1:
Define $\omega_2^+ \equiv \rho_2^* + C/(1-\tau)$. Then

$$\begin{aligned}
\frac{d\left(\frac{dr_2}{dx}|_{b_1}b_1\right)}{d\tau} \;=\; & \frac{\frac{\partial \omega_2^*}{\partial \tau}f(\omega_2^*)-\frac{\partial \omega_2^+}{\partial \tau}f(\omega_2^+)+\frac{C}{1-\tau}\frac{\partial \omega_2^*}{\partial \tau}f'(\omega_2^*)+\frac{C}{(1-\tau)^2}f(\omega_2^*)}{(1-F(\omega_2^*)-Cf(\omega_2^*))} \\
& -\frac{\left(F(\omega_2^*)-F(\omega_2^+)+\frac{C}{1-\tau}f(\omega_2^*)\right)\left(-\frac{\partial \omega_2^*}{\partial \tau}f(\omega_2^*)-C\frac{\partial \omega_2^*}{\partial \tau}f'(\omega_2^*)\right)}{(1-F(\omega_2^*)-Cf(\omega_2^*))^2}.
\end{aligned}$$

The sign of this derivative depends on the numerators which can be rearranged to

$$\begin{aligned}
&\frac{\partial \omega_2^*}{\partial \tau}f(\omega_2^*)\left(1-F(\rho_2^*+C)\right) \\
&-\frac{\partial \rho_2^*}{\partial \tau}f(\rho_2^*+C)\left(1-F(\omega_2^*)\right) \\
&+\xi(C)\ ,
\end{aligned}$$

where $\xi(C)$ contains all the other terms and $\xi(0)=0$. Thus

$$\frac{d\left(\frac{dr_2}{dx}|_{b_1}b_1\right)}{d\tau}>0$$

if

$$\frac{\partial \omega_2^*}{\partial \tau}\frac{f(\omega_2^*)}{1-F(\omega_2^*)} > \frac{\partial \rho_2^*}{\partial \tau}\frac{f(\rho_2^*)}{1-F(\rho_2^*)}$$

and $C = 0$. If $x < \rho^+$ implies $\partial r_2/\partial \tau < 0$, then $\partial \omega_2^*/\partial \tau < \partial \rho_2^*/\partial \tau < 0$ (conditional on b_1). Then a necessary condition for the inequality above to hold is

$$\frac{f(\rho_2^*)}{1-F(\rho_2^*)} > \frac{f(\omega_2^*)}{1-F(\omega_2^*)}.$$

For $\partial r_2/\partial \tau > 0$ this inequality is even a sufficient condition. ■

Derivation of $du_2^b/dx|_{b_1}$:

$$\begin{aligned}
\frac{du_2^b}{dx}|_{b_1} &= -b_1\frac{dr_2}{dx}|_{b_1}\int_{\omega_2^*}^{\infty} u'((1-\tau)\rho_2(\omega_2)+\tau\rho^+)f(\omega_2)d\omega_2 \\
&\quad+\left(\frac{\partial \omega_2^*}{\partial x}+\frac{\partial \rho_2^*}{\partial x}\right)(u(x)-u(x))\,f(\omega_2^*) \\
&\quad+(F(\omega_2^*)-F(\rho_2^*))\,u'(x)
\end{aligned}$$

which simplifies to the expression in the text.

Proof of Remark 2:

Totally differentiating (8) for given b_1,

$$\begin{aligned}
\frac{d\left(\frac{du_2^b}{dx}|_{b_1}\right)}{d\tau} &= -\frac{d\left(\frac{dr_2}{dx}|_{b_1}b_1\right)}{d\tau}(1-\tau)\int_{\omega_2^*}^{\infty} u'(\widetilde{\rho}_2(\omega_2))f(\omega_2)d\omega_2 \\
&\quad+b_1\frac{dr_2}{dx}|_{b_1}\int_{\omega_2^*}^{\infty} u'(\widetilde{\rho}_2(\omega_2))f(\omega_2)d\omega_2 \\
&\quad+\frac{dr_2}{dx}|_{b_1}b_1\int_{\omega_2^*}^{\infty}(\rho_2(\omega_2)-\rho^+)\;u''(\widetilde{\rho}_2(\omega_2))f(\omega_2)d\omega_2 \\
&\quad+\frac{dr_2}{dx}|_{b_1}b_1\;\frac{\partial \omega_2^*}{\partial \tau}u'(x)f(\omega_2^*) \\
&\quad+\left(\frac{\partial \omega_2^*}{\partial \tau}f(\omega_2^*)-\frac{\partial \rho_2^*}{\partial \tau}f(\rho_2^*)\right)u'(x)\;.
\end{aligned}$$

where

$$\frac{\partial \omega_2^*}{\partial \tau} < \frac{\partial \rho_2^*}{\partial \tau} = 0\;.$$

if the agent receives transfers at the bankruptcy threshold. We assume that redistribution is such that agents pay taxes if they are able to repay their debt in full: $\rho_2(\omega_2)-\rho^+ > 0$, for $\omega_2 > \omega_2^*$.

Now recall that the sufficient condition of Remark 1 implies for negligible bankruptcy cost ($C = 0$), that $d\left(\frac{dr_2}{dx}|_{b_1}b_1\right)/d\tau > 0$. If agents cannot tax deduct their debt then the second line of the derivative vanishes (which otherwise would be positive). Furthermore, given that $dr_2/dx|_{b_1} > 0$ and utility is strictly concave, $u''(\bullet) < 0$, we then know that the third and fourth line of the derivative are negative. If the density is increasing, $f(\omega_2^*) > f(\rho_2^*)$, then also the fifth line is negative so that the derivative can be unambiguously signed to be negative ■

Derivation of $d\left(du_2^b/dx|_{b_1}\right)/d\rho^+$**:**

$$\begin{aligned}\frac{d\left(\frac{du_2^b}{dx}|_{b_1}\right)}{d\rho^+} &= -\frac{d\left(\frac{dr_2}{dx}|_{b_1}b_1\right)}{d\rho^+}(1-\tau)\int_{\omega_2^*}^{\infty} u'(\widetilde{\rho}_2(\omega_2))f(\omega_2)d\omega_2 \\ &\quad -\tau\frac{dr_2}{dx}|_{b_1}b_1\int_{\omega_2^*}^{\infty} u''(\widetilde{\rho}_2(\omega_2))f(\omega_2)d\omega_2 \\ &\quad -\frac{\tau}{1-\tau}\frac{dr_2}{dx}|_{b_1}b_1\; u'(x)f(\omega_2^*) \\ &\quad -\frac{\tau}{1-\tau}\left(f(\omega_2^*)-f(\rho_2^*)\right)u'(x)\end{aligned}$$

It is easy to see that

$$\frac{d\left(\frac{dr_2}{dx}|_{b_1}b_1\right)}{d\rho^+} > 0$$

under analogous conditions as for $d\tau$. Thus everything is much the same qualitatively but for the effect in the second line: a larger ρ^+ implies less taxation in the good states, thus the marginal-utility cost of exemption in terms of interest payments decreases. Of course, the effect of tax-deductible debt is not present here.

Proof of Remark 3:

We assume that agents have not declared bankruptcy in period 1 so that $\widetilde{\rho}_1^{\,b} = \rho_1 - \tau(\rho_1-\rho^+)$. Below we mention where a different endowment $\widetilde{\rho}_1^{\,b}$ would make a difference.

Totally differentiating the Euler equation (10) we find

$$\frac{db_1}{dx}|_{r_2} = -\frac{\frac{\beta(1+r_2)}{1-\tau}u'(x)f(x)}{u''(\widetilde{\rho}_1+b_1)+\beta(1+r_2)^2(1-\tau)\left\{\int_{\varepsilon_2^*}^{\infty}u''(\widetilde{\rho}_2)dF(\varepsilon_2)+u'(x)f(x)\right\}} > 0$$

$$\frac{db_1}{d\tau}|_{r_2} = -\frac{(\rho^+-\rho_1)u''(\widetilde{\rho}_1+b_1)+\beta(1+r_2)(\rho_2-\rho^+)\left(\int_{\varepsilon_2^*}^{\infty}u''(\widetilde{\rho}_2)dF(\varepsilon_2)+\overbrace{\frac{\partial\varepsilon_2^*}{\partial\tau}}^{\leq 0\ if\ x\leq\rho^+}u'(x)f(x)\right)}{u''(\widetilde{\rho}_1+b_1)+\beta(1+r_2)^2(1-\tau)\left\{\int_{\varepsilon_2^*}^{\infty}u''(\widetilde{\rho}_2)dF(\varepsilon_2)+u'(x)f(x)\right\}}$$

$$\frac{db_1}{d\mu}|_{r_2} = \frac{\beta(1+r_2)(1-\tau)\left\{\int_{\varepsilon_2^*}^{\infty}u''(\widetilde{\rho}_2)dF(\varepsilon_2)+u'(x)f(x)\right\}}{u''(\widetilde{\rho}_1+b_1)+\beta(1+r_2)^2(1-\tau)\left\{\int_{\varepsilon_2^*}^{\infty}u''(\widetilde{\rho}_2)dF(\varepsilon_2)+u'(x)f(x)\right\}}$$

and

$$\frac{db_1}{d\varepsilon_1}|_{r_2} = -\frac{(1-\tau)u''(\widetilde{\rho}_1+b_1)-\beta(1+r_2)\alpha(1-\tau)\left\{\int_{\varepsilon_2^*}^{\infty}u''(\widetilde{\rho}_2)dF(\varepsilon_2)+u'(x)f(x)\right\}}{u''(\widetilde{\rho}_1+b_1)+\beta(1+r_2)^2(1-\tau)\left\{\int_{\varepsilon_2^*}^{\infty}u''(\widetilde{\rho}_2)dF(\varepsilon_2)+u'(x)f(x)\right\}}$$

For $\alpha = 0$, the latter simplifies to

$$\frac{db_1}{d\varepsilon_1}|_{r_2} = -\frac{(1-\tau)u''(\widetilde{\rho}_1 + b_1)}{u''(\widetilde{\rho}_1 + b_1) + \beta(1+r_2)^2(1-\tau)\left\{\int_{\varepsilon_2^*}^{\infty} u''(\widetilde{\rho}_2)dF(\varepsilon_2) + u'(x)f(x)\right\}} < 0$$

The Euler equation implies that b_1 is optimally chosen. Thus, the derivative of the Euler equation with respect to b_1 is negative for strictly concave utility functions. Therefore the denominator of all total derivatives is negative so that $db_1/d\varepsilon_1|_{r_2} < 0$ if $\alpha = 0$ and $db_1/dx|_{r_2} > 0$. If the agent has declared bankruptcy in period 1, $\rho_1^b = x$, there is an additional negative term in the numerator of the latter derivative: $+u''(x)$. In this case more abundant bankruptcy exemption increases resources already in period 1 which lowers the desire to borrow ceteris paribus.

A larger τ is more likely to decrease b_1 if it compresses the resources in period 1 and period 2: $\rho^+ > \rho_1$ and $\rho_2 > \rho^+$; and certainly so if $\rho^+ \geq x$.

Higher expected labor income (a larger μ) increases borrowing if

$$-\frac{\int_{\varepsilon^*}^{\infty} u''(\widetilde{\rho}_2)dF(\varepsilon_2)}{u'(x)} > f(x)$$

Strict concavity of the utility function implies that a necessary condition for this inequality to hold is

$$-\frac{u''(x)}{u'(x)} > f(x)$$

■

Derivation of $da_1/d\tau$ and $da_1/d\mu$:
Totally differentiating the Euler equation (11),

$$\begin{aligned}
& -u''(\rho_1 - \tau(\rho_1 - \rho^+) - a_1)da_1 \\
& -\beta(1+r_f)^2(1-\tau)\left(\int_{-\infty}^{\infty} u''(\underbrace{\mu + \alpha\varepsilon_1 + \varepsilon_2 + (1+r_f)a_1}_{=\rho_2} - \tau(\rho_2 - \rho^+))dF(\varepsilon_2\right) da_1 \\
& -\beta(1+r_f)(1-\tau)\left(\int_{-\infty}^{\infty} u''(\underbrace{\mu + \alpha\varepsilon_1 + \varepsilon_2 + (1+r_f)a_1}_{=\rho_2} - \tau(\rho_2 - \rho^+))dF(\varepsilon_2)\right) d\mu \\
= \;& 0
\end{aligned}$$

Thus,

$$\frac{da_1}{d\mu}|_{r_2} = -\frac{\beta(1+r_f)(1-\tau)\int_{-\infty}^{\infty} u''(\widetilde{\rho}_2)dF(\varepsilon_2)}{u''(\widetilde{\rho}_1 + b_1) + \beta(1+r_f)^2(1-\tau)\int_{-\infty}^{\infty} u''(\widetilde{\rho}_2)dF(\varepsilon_2)} < 0$$

and

$$\frac{da_1}{d\tau}|_{r_2} = -\frac{(\rho_1 - \rho^+)\, u''(\widetilde{\rho}_1 - a_1) - \beta(1+r_f)(\rho_2 - \rho^+)\int_{-\infty}^{\infty} u''(\widetilde{\rho}_2)dF(\varepsilon_2)}{u''(\widetilde{\rho}_1 + b_1) + \beta(1+r_f)^2(1-\tau)\int_{-\infty}^{\infty} u''(\widetilde{\rho}_2)dF(\varepsilon_2)} .$$

Appendix B: Data sources and descriptive statistics

The *Consumer Expenditure Survey* (CEX) is a widely used survey of US households that has operated on a continuous basis since 1980. It contains detailed information on both consumer expenditure and the demographic and other characteristics of the household but it contains less accurate information on saving and secured borrowing. The Bureau of Labor Statistics (BLS) collects the data to construct the consumer price index and hence the data-set contains extremely detailed information on the sub-components of consumption and, crucially, the state of residence of the household. The survey is designed as a rotating panel, with households being interviewed 5 times at quarterly intervals (although the first is a contact interview from which no information is made available). Each quarter, households reaching their fifth interview drop out and are replaced by a new household. Since the survey records detailed information on individual expenditure items, we can construct a measure of non-durable consumption which includes food and beverages, tobacco, housekeeping services, fuel, public utilities, repairs, public transport, personal care, entertainment, clothing and books, each deflated by the appropriate price index. Since 1988, households have also been asked detailed questions about their financial position, and in particular about all their outstanding it unsecured debt (which includes specific and separate questions on credit-card debt, debt on store cards, bank debt, debt at savings and loans companies, credit unions, finance companies and other sources, and medical debt). While each household is interviewed 5 times, questions on debt are only asked in the second and fifth interview. We only use information of one of these interviews (to avoid issues concerned with correlation across observations) and deflate the debt data by average incomes ion the state that year (measured from the CPS). Consumption, on the other hand, was deflated using a household specific Stone-Geary price index for non-durable expenditure so that it is in 1984 dollars. Given the detail of the questionnaire, the information on debt in the CEX is of comparable quality as in the more widely used Survey of Consumer Finances (SCF). Moreover, the CEX contains state information while the Survey of Consumer Finances only provides state information in a single year, 1983. In the CEX, the median debt in the whole sample is $736 for the period 1988-93, and 68% of households hold at least some debt. Conditional on holding debt, the average debt is $3,984, similar to estimates in Cox and Jappelli (1993) based on the SCF.

Information on household level income and transfers is obtained from the *March supplement of the Current Population Survey* (CPS). This survey is also managed by the BLS, and is designed to give very detailed and accurate information on the household's current income and demographics. Income is defined as total household labor income. The CPS has the advantage of being a much larger survey than the CEX. The CPS also contains information on transfers such as social security and railroad retirement income, supplementary security income, unemployment compensation, worker's compensation and veterans payments, public assistance or welfare, and the value of food stamps received. Some summary statistics of the annual amount that households receive are reported in Table 3. The table shows that 94.3 percent of the sample households were receiving at least some wage income, and that the average level of wage income was $34,700 (in current dollars). The average wage among wage-earners was slightly higher at $36,800. On average the households in the sample received just under $1,000 of public transfers, although among the 23 percent of households that received at least some income, this transfer income was much larger, at $4,250. The table also shows some of the most important components of this transfer income. For example, if agents receive 'social security', average transfers amount to $6,600. However, less than four percent of households receive this category of transfer. The most common transfer are unemployment benefits or worker compensation, where an average amount of about $2,700 is received by more than 13% of households. Among all households in the sample, the average level of unemployment benefit was around $350 and amounts to more than one third of all the received public transfers.

Table 4 shows the *federal tax schedule* in 1998. The marginal tax rate varies from 15% for single filers whose income is below $26,250 to 39.6% for incomes over $288,350. The income at which these rates apply are slightly lower for couples filing separately, while if the couple files jointly the brackets start at twice the income of the couple filing separately. These tax rates and the tax brackets themselves vary substantially from year to year. Prior to 1996 the bottom bracket was set at zero, which meant that between 15 and 20% of the low-income households paid no federal income tax. Furthermore, in 1987, the number of brackets was considerably reduced.

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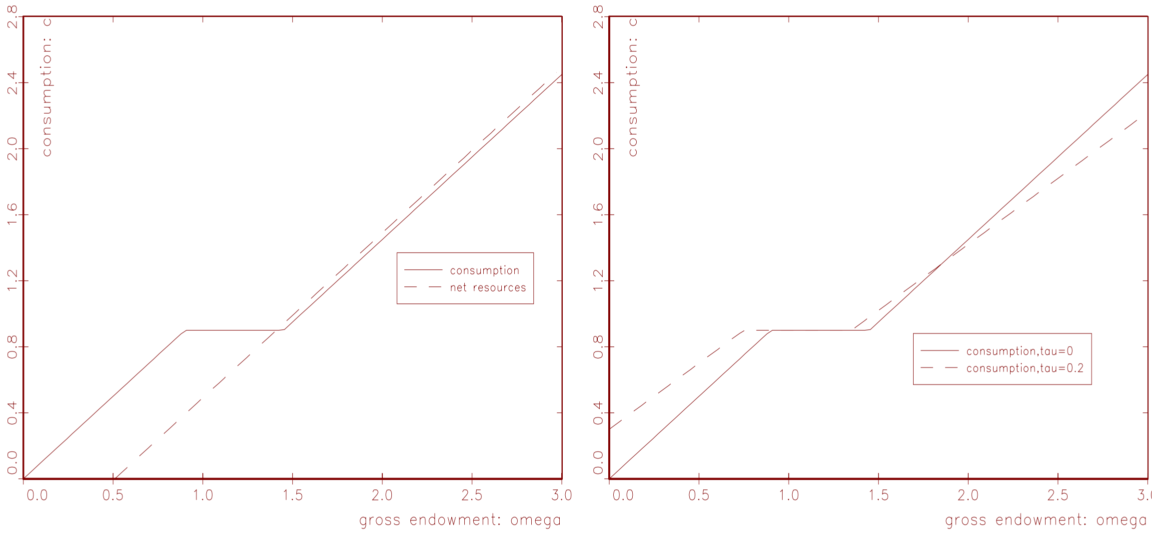

Figure 1: Consumption as a function of gross endowment for positive exemption x and different transfers τ

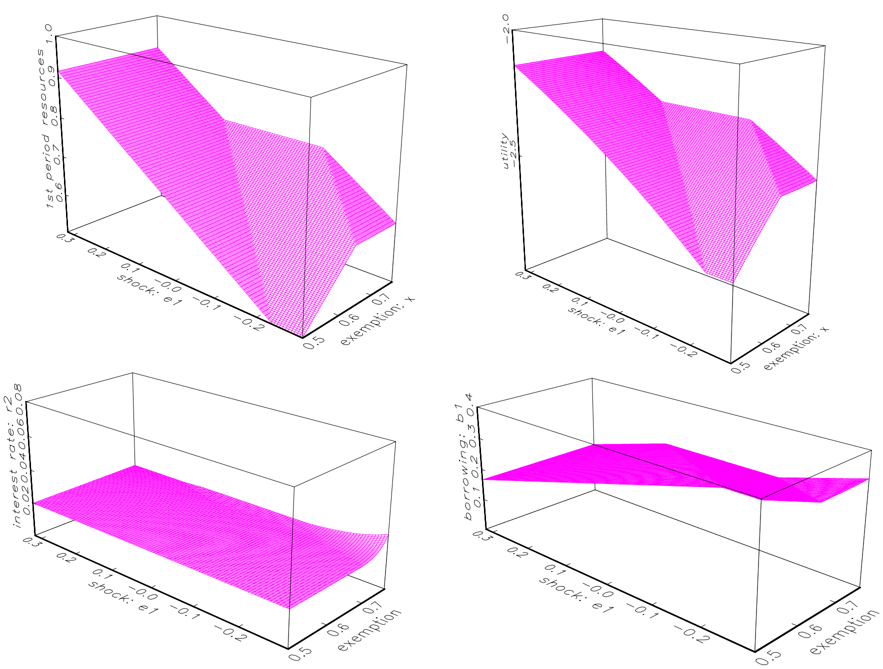

Figure 2: No Persistence ($\alpha = 0$): first-period net resources (before taking on new debt b_1), the interest rate r_2, the amount borrowed b_1, and utility U_1^b as a function of the realization ε_1 and exemption level x.

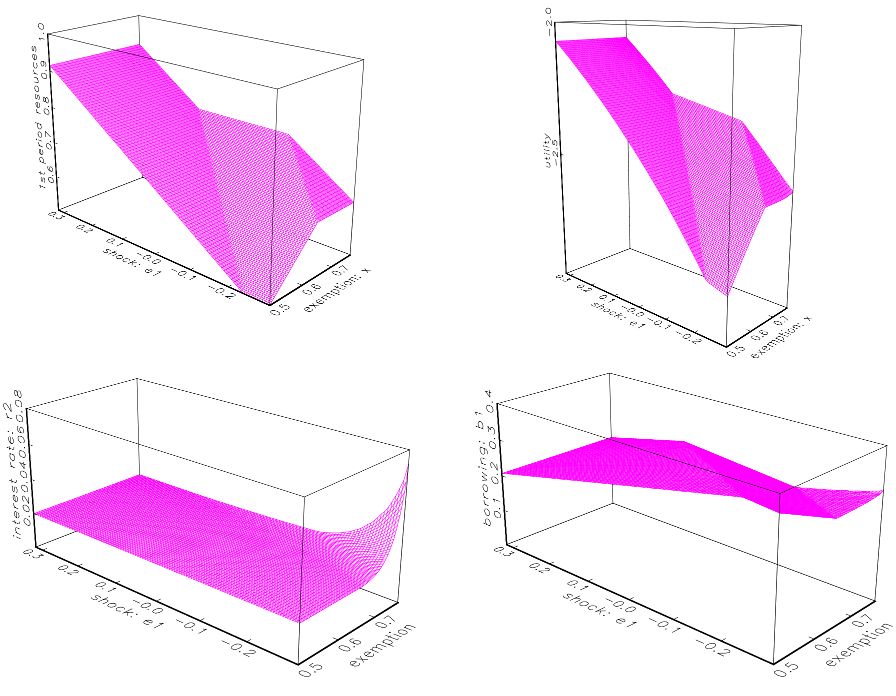

Figure 3: Persistence ($\alpha = .3$): first-period net resources (before taking on new debt b_1), the interest rate r_2, the amount borrowed b_1, and utility U_1^b as a function of the realization ε_1 and exemption level x.

Table 1: Equilibrium values of borrowing b, interest rate r, and default probability

Variables	*Benchmark*	$\tau = 0.25$	$x = 0.85$	$\mu = 1.3$	$C = 0.05$	$\sigma = 1$
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
borrowing b	0.1854	0.179	0.186	0.139	0.1846	0.21
interest rate r	0.0321	0.0325	0.025	0.045	0.034	0.037
default prob.	0.0137	0.012	0.005	0.025	0.0136	0.021

In the benchmark case, the risk-free interest rate $r_f = 0.02$, $\omega_1 = 1$, the bankruptcy cost $C = 0.015$, the . bankruptcy exemption $x = 0.9$, the coefficient of risk-aversion $\sigma = 2$, the discount rate $\beta = (1 + 0.1)^{-1}$, $\mu = 1.4$, the marginal tax rate $\tau = 0.2$ while the temporary income shock $\varepsilon \sim N(0, 0.1 * \omega_2)$

Table 2: Optimal bankruptcy exemption x^*

Variables	*Period 1*	*Period 0* $\alpha = 0$	*Period 0* $\alpha = 0.3$
	(1)	**(2)**	**(3)**
$\tau = .2$	0.871	0.874	0.863
$\tau = .25$	0.845	0.848	0.843
elasticity(x^*,τ)	-0.12	-0.12	-0.09

The first two rows display the optimal bankruptcy exemption. The third row displays the implied elasticity between the optimal exemption and tax rates. Period 0 and Period 1 refer to the optimal exemption level evaluating the indirect utility of a borrower in period 0 or 1, respectively. If not otherwise mentioned in the Table, the parameter values are as described in the footnote of Table 1.

Table 3: The level of wages and transfers for households in the US:

	average	average if received	% receive
wages	34,696	36,789	94.3
social security	261	6,601	3.9
supplementary security income	77	4,161	1.8
unemployment/workers compensation	353	2,688	13.1
public assistance / welfare	176	3,712	4.7
food stamps	128	1,571	8.1
total transfer	997	4,250	23.4

Data is constructed from reported responses in the March supplement of the CPS for the years 1980-1999. Total transfer refers to the sum of social security benefits, supplementary security benefits, unemployment or workers compensation, welfare or other public assistance, and food stamps. The CPS questionnaire conflates social security benefits with railroad retirement income, and worker's compensation with veterans payments.

Table 4: Income thresholds for 1998 federal tax brackets:

Tax Rate (%)	Tax Bracket single	married jointly	married separately	% paying
15	0	0	0	58.2
28	26,250	43,850	21,925	34.2
31	63,550	105,950	52,975	5.2
36	132,660	161,450	80,725	1.8
39.6	288,350	288,350	144,175	0.3

The data was made available by the Federation of Tax Administrators at 444 N. Capital Street, Washington DC. In the table 'single' refers to single filers, 'married jointly' refers to married couples filing jointly, while 'married separately' refers to married couples who file separate tax returns. '% paying' refers to the proportion of households in the tax bracket. The amounts for the tax bracket refer to the income at which the tax bracket starts.

Table 5: Chapter 7 Exemptions under the Federal Bankruptcy Act.

Description	Amount $	Comments
1978 Exemptions:		
1. House	7,500	
2. Car	1,200	
3. Household Goods		no limit on aggregate amount that can be claimed under this category.
4. Jewelry	500	personal use only.
5. Other Property		Allowed all of unclaimed exemption from (1).
6. Tools of Trade	750	Items needed for job.
Revised Exemptions of 1984:		
3. Household Goods	4,000	$200 each item. (furnishings, goods, clothes, appliances, books, animals, musical instruments) for personal use only.
5. Other Property	400	+ $3,750 of (1) that is unused.
Revised Exemptions of 1994:		
1. House	15,000	
2. Car	2,400	
3. Household Goods	8,000	$400 each item.
4. Jewelry	1,000	
5. Other Property	800	+ $7,500 of (1) that is unused.
6. Tools of Trade	1,500	
Revised Exemptions of 1998:		
1. House	16,150	
2. Car	2,575	
3. Household Goods	8,625	$425 each item.
4. Jewelry	1,075	
5. Other Property	850	+ $8,075 of (1) that is unused.
6. Tools of Trade	1,625	
Revised Exemptions of 2001:		
1. House	17,425	
2. Car	2,775	
3. Household Goods	9,300	$450 each item.
4. Jewelry	1,150	personal use only.
5. Other Property	925	+ $8,725 of (1) that is unused.
6. Tools of Trade	1,750	

Source: Title, 11, Section 522(d) of the annotated federal code. Section 104 specified that the amounts were to be updated with the inflation rate every 3 years, commencing on April 1st 1998. While not recorded, the federal legislation also allowed (with some limits) insurance policies, pensions and annuities, social security payments, and awards adjudicated by the courts to be exempted.

Table 6: Tax redistribution and bankruptcy exemptions by state:

State	Taxes					Bankruptcy Exemptions					
	min. bracket	max. bracket	exempt	marginal rate	income compression	house '84	other '84	house '98	other '98	fed	debtors
California	1.0	9.3	72	22.8	34.3	30,000	5,200	50,000	10,900	1984	62.3
Florida	no state income tax			19.2	27.0	no limit	1,000	no limit	2,000	1979	60.1
Maryland	2.0	4.75	1,850	25.1	32.6	2,500	3,500	2,500	3,500	1982	67.3
Minnesota	5.35	7.85	2,900	24.6	34.3	no limit	6,500	200,000	11,050		72.1
New York	4.0	6.85	-	22.1	35.5	10,000	7,400	10,000	7,400	1982	52.8
Pennsylvania	2.8	2.8	-	21.0	29.8		300		300		64.5
Texas	no state income tax			19.0	26.9	no limit	15,000	no limit	30,000		65.7

The tax brackets are those applicable in 1998, while the exemption is the income exempt from taxation for single filers. The California exempt amount refers to a tax credit. Tax data is constructed using income from the March supplement of the CPS for 1980-1999, and using taxes reported from the NBER TAXSIM programme. 'Marginal tax rate' refers to the mean marginal tax rate across households, the 'tax bracket' is the mean tax bracket across households while 'income compression' refers to 1 minus to the ratio of the standard deviation of income before taxes to the standard deviation of income after taxes (and transfers). The income compression measure accounts for both state and federal taxes. The bankruptcy exemptions are those applicable on 1 January in 1984 and 1998, while 'other' refers to the money amount on all assets excluding housing and 'tools of trade'. California refers to system I exemptions. The column 'fed' refers to the year in which the federal exemption was not allowed, while 'debtors' refers to the proportion of households in the state with at least some unsecured debt.

Table 7: The effect of taxes and bankruptcy exemptions on unsecured debt.

	Tobits			CLAD			CLAD-IV		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
tax	-0.201	1.302	-0.201	0.952	1.812	-0.170	-4.303	3.641	3.326
	(1.147)	(2.060)	(0.657)	(1.642)	(1.987)	(0.823)	(8.504)	(4.405)	(8.298)
exemption × (1-house)	-0.691	-0.697	-0.690	-0.176	-0.189	-0.171	-0.189	-1.066	-0.312
	(0.203)	(0.203)	(0.202)	(0.317)	(0.274)	(0.295)	(0.427)	(0.471)	(0.464)
exemption × house	0.125	0.123	0.125	0.231	0.230	0.230	0.251	0.058	0.283
	(0.048)	(0.048)	(0.048)	(0.065)	(0.058)	(0.066)	(0.090)	(0.091)	(0.106)
house fully exempt	0.369	0.366	0.368	0.438	0.428	0.440	0.317	0.052	0.250
	(0.124)	(0.124)	(0.124)	(0.189)	(0.170)	(0.184)	(0.286)	(0.300)	(0.297)
age/10	-4.846	-4.860	-4.836	-8.633	-8.638	-8.559	-18.07	-17.43	-15.39
	(2.390)	(2.390)	(2.390)	(3.518)	(3.367)	(3.740)	(5.307)	(5.599)	(5.302)
age/10-squared	1.182	1.186	1.180	2.158	2.162	2.140	4.356	4.225	3.762
	(0.550)	(0.550)	(0.550)	(0.830)	(0.792)	(0.878)	(1.240)	(1.332)	(1.261)
age/10-cubed	-0.098	-0.098	-0.098	-0.180	-0.180	-0.178	-0.346	-0.338	-0.303
	(0.041)	(0.041)	(0.041)	(0.064)	(0.061)	(0.067)	(0.094)	(0.103)	(0.097)
finished school	0.985	0.986	0.985	0.899	0.901	0.914	0.946	1.138	0.950
	(0.084)	(0.084)	(0.084)	(0.167)	(0.174)	(0.167)	(0.251)	(0.258)	(0.273)
some college	1.319	1.320	1.319	1.087	1.096	1.105	1.101	1.255	1.179
	(0.086)	(0.086)	(0.086)	(0.161)	(0.181)	(0.169)	(0.267)	(0.258)	(0.260)
full college degree	0.829	0.834	0.834	0.678	0.678	0.699	0.642	0.766	0.718
	(0.088)	(0.088)	(0.088)	(0.164)	(0.172)	(0.176)	(0.263)	(0.265)	(0.267)
black	-0.550	-0.550	-0.550	-0.485	-0.476	-0.477	-0.569	-0.335	-0.592
	(0.067)	(0.067)	(0.067)	(0.103)	(0.117)	(0.117)	(0.172)	(0.155)	(0.159)
female	-0.208	-0.209	-0.208	-0.261	-0.254	-0.262	-0.334	-0.145	-0.333
	(0.051)	(0.051)	(0.051)	(0.071)	(0.074)	(0.063)	(0.098)	(0.108)	(0.102)
couple	-0.140	-0.139	-0.139	-0.040	-0.061	-0.079	-0.349	-0.206	0.002
	(0.187)	(0.187)	(0.187)	(0.263)	(0.226)	(0.241)	(0.385)	(0.390)	(0.377)
ln(family-size)	1.027	1.026	1.026	0.871	0.911	0.929	1.707	1.029	0.524
	(0.347)	(0.347)	(0.347)	(0.438)	(0.440)	(0.411)	(0.693)	(0.681)	(0.605)
ln(family-size)-squared	-0.388	-0.387	-0.387	-0.333	-0.350	-0.357	-0.719	-0.391	-0.141
	(0.155)	(0.155)	(0.155)	(0.188)	(0.193)	(0.185)	(0.307)	(0.298)	(0.256)
ln(income)	2.888	2.886	2.889	23.236	23.121	23.536	16.107	22.488	19.183
	(0.318)	(0.318)	(0.318)	(2.780)	(2.523)	(2.980)	(3.290)	(3.818)	(3.355)
ln(income)-squared	-0.120	-0.120	-0.120	-1.100	-1.095	-1.114	-0.753	-1.067	-0.909
	(0.016)	(0.016)	(0.016)	(0.135)	(0.121)	(0.144)	(0.159)	(0.186)	(0.163)
interest rate	-0.001	-0.001	-0.001	-0.002	-0.001	-0.002	-0.004	-0.005	0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)

Estimated with a tobit in the first three columns and by CLAD in the last six (with bootstrapped standard errors, in parentheses, using 200 repetitions) for all households in the 18 largest states whose head was between 30 and 60 years old. Month, year and state dummies are included. The last three columns instrumented taxes with the political variables. Unsecured debts and the bankruptcy exemptions are measured in logs. 'House fully exempt' is a dummy with the value one if there is no upper limit to the value of the housing exemption. The interest rate is the real municipal bond rate. Columns (1) (4) and (7) use the income compression measure of taxes, (2), (5) and (8) uses the mean marginal tax rate, while columns (3) (6) and (9) uses the poverty ratio. The sample size was 22,746, and the log-likelihood was -44,038 in the tobits.

Table 8: The effect of taxes and bankruptcy exemptions on inequality.

	income compression				mean marginal tax rate				inverse poverty index			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	$sd(c_{it})$	$sd(\Delta c_{it})$	$sd(\Delta c_{it})$	$sd(\Delta c_{it})$	$sd(c_{it})$	$sd(\Delta c_{it})$	$sd(\Delta c_{it})$	$sd(\Delta c_{it})$	$sd(c_{it})$	$sd(\Delta c_{it})$	$sd(\Delta c_{it})$	$sd(\Delta c_{it})$
tax	-0.126	-0.372	-0.455	-0.751	-0.156	-0.482	-0.464	-0.574	-0.071	-0.250	-0.145	-0.382
	(0.077)	(0.131)	(0.205)	(0.178)	(0.070)	(0.118)	(0.146)	(0.138)	(0.037)	(0.063)	(0.108)	(0.089)
exemption	-0.018	-0.030	-0.036	-0.036	-0.019	-0.032	-0.038	-0.034	-0.018	-0.028	-0.028	-0.032
	(0.010)	(0.018)	(0.022)	(0.020)	(0.010)	(0.018)	(0.022)	(0.019)	(0.010)	(0.018)	(0.022)	(0.019)
house dummy	-0.049	0.054	0.010	0.068	-0.048	0.058	0.012	0.076	-0.050	0.053	0.011	0.069
	(0.019)	(0.033)	(0.033)	(0.035)	(0.019)	(0.032)	(0.033)	(0.034)	(0.019)	(0.032)	(0.033)	(0.034)
constant	0.725	0.628	0.726	0.818	0.720	0.629	0.684	0.697	0.699	0.561	0.588	0.640
	(0.039)	(0.050)	(0.090)	(0.081)	(0.032)	(0.040)	(0.061)	(0.059)	(0.029)	(0.030)	(0.052)	(0.050)
IV			lag	pol			lag	pol			lag	pol
$Rank - test$			20.82	32.99			30.10	68.58			10.91	17.98
$(prob)$			0.000	0.000			0.000	0.000			0.000	0.000
$Sargan$				6.85				8.99				6.60
$(prob)$				(0.143)				(0.061)				(0.158)
N	348	342	310	306	348	342	310	306	348	342	310	306
R^2	0.175	0.100			0.181	0.122			0.177	0.120		

Standard errors in parentheses. The variable 'house dummy' refers to whether the state allows the home to be exempt from seizure regardless of its value, while IV refers to whether the tax system is instrumented by itself lagged twice (denoted 'lag') or by a set of political instruments (denoted 'pol'). All regressions included a full set of state dummies. The columns are overlabeled with the measure of the tax system that was used in the regression.

Table 9: The relationship between taxes and bankruptcy exemptions.

	income compression			mean marginal tax rate			inverse poverty index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	OLS	IV	IV	OLS	IV	IV	OLS	IV	IV
exemption	-0.016	-0.018	-0.121	-0.016	-0.023	-0.199	-0.022	-0.020	-0.196
	(0.007)	(0.009)	(0.041)	(0.008)	(0.009)	(0.055)	(0.015)	(0.018)	(0.080)
house dummy	-0.016	-0.008	-0.147	-0.004	-0.001	-0.021	-0.036	-0.007	-0.268
	(0.013)	(0.014)	(0.092)	(0.015)	(0.015)	(0.123)	(0.028)	(0.028)	(0.179)
constant	0.374	0.375	0.541	0.275	0.282	0.613	0.313	0.258	0.595
	(0.019)	(0.019)	(0.077)	(0.020)	(0.021)	(0.103)	(0.039)	(0.039)	(0.149)
IV		lag	pol		lag	pol		lag	pol
$Rank - test$		240.86	12.78		240.86	12.78		240.86	12.78
$(prob)$		0.000	0.000		0.000	0.000		0.000	0.000
N	348	329	312	348	329	312	348	329	312
R^2	0.248			0.129			0.076		

Standard errors in parentheses. The variable 'house dummy' refers to whether the state allows the home to be exempt from seizure regardless of its value, while IV refers to whether the tax system is instrumented by itself lagged twice (denoted 'lag') or by a set of political instruments (denoted 'pol'). All regressions included a full set of state dummies. The columns are overlabeled with the measure of the tax system that was used in the regression.