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Abstract

We show that redistributive tax and transfer systems have a distortionary effect and an insurance effect, if agents face idiosyncratic uninsurable earnings risk. These two effects imply that redistributive taxes decrease both mean consumption and the standard deviation of consumption. Using household data, we construct an 'income compression' measure of the redistributiveness of the tax system and empirically test for the presence of these two effects by exploiting differences in US state taxes. We find that tax redistributiveness explains much of the variation in the mean and standard deviation of the within-state consumption distributions over the US. This provides evidence for the presence of both distortionary and insurance effects of redistributive taxes and transfers.

JEL Classification: E21, H20, H31

Keywords: Undiversifiable Earnings Risk, Tax Distortions, Insurance

1 Introduction

Much analysis of household consumption focuses on the study of choices made by forward-looking wealth-accumulating agents who face exogenous idiosyncratic labor-income shocks and liquidity constraints.[1] This micro approach to consumption choice has been incorporated into workable applied macro models since the pioneering work by Bewley (1986), Huggett (1993) and Aiyagari (1994), taking macroeconomic analysis beyond the representative agent. Yet, the inclusion of idiosyncratic risk in a macro framework gave immediate rise to policy issues. Even in an economy with no externalities, due to market incompleteness, idiosyncratic risk cannot be insured, and hence the competitive equilibrium is not Pareto efficient. Liquidity constraints exist in equilibrium, and agents face the probability of not being able to smooth consumption through borrowing.[2]

The possibility for Pareto improvement in economies with idiosyncratic risk has led several authors to challenge the view that marginal taxes on capital and labor income, in the absence of externalities, always lead to welfare deteriorations.[3] In a macroeconomy with capital accumulation and idiosyncratic risk, redistributive taxes and transfers on capital and labor income are expected to have two distinct long-run effects on consumption: (i) they

[1]For example, Deaton (1991), Carroll (1997), Hubbard, Skinner, Zeldes (1995), and Gourinchas and Parker (2002) offer supporting evidence that some combination of precautionary saving and/or liquidity constraints can be important determinants of saving and consumption dynamics.

[2]This point is discussed in Aiyagari (1994).

[3]For example, Aiyagari (1995) extended the Chamley (1986) model to include idiosyncratic labor risk and showed that the *optimal* long-run marginal tax on capital is positive. More recently, Conesa, Kitao and Krueger (2006), argued that the optimal tax rate on capital should be 36% in an overlapping-generations model with idiosyncratic risk.

should decrease the observed long-run mean of consumption as marginal taxes reduce the incentives for saving and capital accumulation, and (ii) they should decrease the observed standard deviation of consumption across households, through decreasing the effective fluctuations of after-tax individual income.[4]

The traditional approach without idiosyncratic risk has emphasized the first or distortionary effect of taxes which reduces average consumption and reduces welfare. But if households face uninsured idiosyncratic risk there is also a second and countervailing insurance effect of redistributive taxes which reduces each household's consumption variability and raises welfare. The relative importance of these two effects is crucial for the evaluation of fiscal policy in macro models with idiosyncratic risk. Hence it is important to empirically test whether the distortionary and insurance effects of redistribution through the tax and benefit system can indeed be observed in the data. To test for these effects is therefore a main aim of our study.

Our analysis starts by simulating a benchmark model of idiosyncratic labor-income shocks that demonstrates the distortionary and the insurance effect of redistributive taxes (and transfers) on the stationary distribution of consumption. In models of this type, both the mean and the standard deviation of cross-sectional consumption fall when taxes rise. For plausible parameters, the insurance effect is sufficiently strong for the coefficient of variation to fall as taxes increase. Moreover, below some threshold (which depends on the parameters of the model) welfare improves as taxes increase since the insurance effect dominates, but

[4]Transfers can also relax liquidity constraints, which again increases consumption smoothing and reduces the need for precautionary saving.

welfare falls above this threshold point.[5]

The core of the paper is devoted to examining the empirical evidence on the effect of taxes and transfers on the mean, the standard deviation, and the coefficient of variation of consumption, and to quantifying this effect. We use data for different US states (treating each state as a small economy) to investigate the relationship within each state between redistribution through taxes and transfers, and the distribution of household consumption.

We utilize individual consumption data from about 100,000 American households from the Consumer Expenditure Survey (CEX), while we collect household income data from the Current Population Survey (CPS). We calculate the taxes paid by each individual using the TAXSIM program provided by the NBER. An important innovation of the paper is to construct a measure of redistribution through the tax system. Using the mean marginal tax rate and/or some aggregate measure of transfers has serious drawbacks (we discuss this further below). Our study uses data on each *household's* income before and after taxes to construct an income compression measure which more directly captures redistribution through taxes and transfers.

Using observations from different US states offers an appropriate 'laboratory' in which to test the empirical implications of the model since, as we show, variation in state-level taxes is substantial, allowing for a meaningful interpolative analysis. In contrast, cross-country variation may instead reflect differences in institutional, cultural and other country-specific features as well as differences in the measurement of the appropriate household level variables

[5]The insurance effect is exactly what gives rise to the study of second-best redistributive policies in the literature. This study does not investigate second-best taxation in a calibrated model, rather, it tests whether the insurance effect is found in the data.

in different surveys. These issues are likely to be much less important when comparing across US states. Moreover, using the same survey across tax regimes reduces the chance that differences in the survey design spuriously generate the different measured policy responses.

We provide evidence that redistribution through the tax and transfer system is negatively correlated with both the mean and the variance of consumption and quantify the size of these effects. We also find that the coefficient of variation of consumption distributions across US states is negatively correlated with redistributive income taxes, indicating a strong insurance effect. Finding evidence for the presence of an insurance effect of taxes on observed cross-sections of the consumption distributions has deeper implications than simply testing the impact of policy. It demonstrates a channel through which the effects of idiosyncratic risk on individual decisions are transmitted to the aggregate level. The insurance effect of taxes is important and demonstrable, hence it is important to stress the appropriate policy tradeoffs (between the distortionary and insurance effects) in models of taxes which incorporate idiosyncratic risk.

The structure of the paper is as follows. In Section 2 we calibrate a benchmark model economy with idiosyncratic risk and show how tax policies imply both a distortionary and an insurance effect on consumption. In Section 3 we describe the data and compare the tax system in different US states. We also propose two measures of tax redistributiveness in the different US states. Section 4 presents the empirical findings and Section 5 concludes.

2 Theoretical underpinnings

In this section we solve a heterogeneous-agent model à la Aiyagari (1994), extended to include an exogenous redistributive policy. We focus on the effects of different redistributive policies on consumption. We emphasize that the goal of this theoretical analysis is to demonstrate the presence of the two effects and not to conduct a comprehensive quantitative analysis of optimal policies.

2.1 The Model

Production of final goods takes place through a large number of identical firms that use capital and labor as inputs. All firms operate a common neoclassical production technology characterized by the Cobb-Douglas production function:

$$\mathbf{y} = F\left(\overline{\mathbf{K}},\ \overline{\mathbf{L}}\right) = \overline{\mathbf{K}}^{\alpha}\overline{\mathbf{L}}^{1-\alpha}$$

with $\alpha \in (0, 1)$. The function F is endowed with the usual neoclassical properties: diminishing marginal returns to each factor, constant returns to scale, and the Inada conditions. Competitive pricing implies that factors of production earn their marginal products:

$$R = F_1\left(\overline{\mathbf{K}}, \overline{\mathbf{L}}\right) \quad \text{and} \quad w = F_2\left(\overline{\mathbf{K}}, \overline{\mathbf{L}}\right)$$

Capital depreciates in each period at the constant rate δ, implying that the user cost is $r = R - \delta$.

We abstract from government spending on public goods, and any possible inefficiency in raising revenue and/or spending by governments, and concentrate solely on the redistributive aspect of taxes and transfers. Policies are exogenous and constant over time. The government imposes a fixed and pre-specified marginal tax rate τ on capital and labor income and redistributes the average tax revenues, T, to all individuals, after paying the interest cost of the steady state government debt, D_t. The government's balanced budget constraint in each period therefore becomes:

$$T_t + rD_t = \tau r\overline{\mathbf{K}}_t + \tau\overline{\mathbf{L}_t}$$

There are a large number of households that derive utility solely from the consumption of the final good. Each household receives an idiosyncratic labor income shock. Households can smooth their consumption profile via the trading of assets A_{it} in a capital market that is characterized by an (exogenous) borrowing constraint. The household pays taxes at rate τ on both capital and labor income, but receives a common per-capita lump-sum transfer T that is financed from this taxation.[6]

There is no aggregate uncertainty, but individuals face idiosyncratic labor income shocks, denoted by Y_{it}. In the stationary equilibrium, all resulting asymptotic distributions in the economy are time-invariant, even though there is substantial mobility at the individual level. Aggregate-economy prices are therefore constant, described by the price vector $\{r, w\}$.

The consumer's problem is:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t u(C_{it})$$

s.t. (for all $t \in \{0, 1, ..\}$):

$$C_{it} + A_{it+1} = [1 + (1-\tau)\, r]\, A_{it} + (1-\tau)\, wY_{it} + T$$

[6]US tax jurisdictions rarely distinguish between these different sources of income when assessing the household's tax liability.

$$A_{it+1} \geq -b$$

where β is the constant discount factor, C_{it} is consumption for individual i at time t; b is the borrowing limit; and T is the per capita transfer. Our computations use the standard CRRA utility function.

$$u(C_{it}) = \frac{C_{it}^{1-\rho}}{1-\rho}$$

with $\rho > 0$.

The computations we report allow no borrowing ($b = 0$) and fix the government debt to be zero.[7] Moreover, following Deaton (1991) and Aiyagari (1994), it is convenient to work with the the total resources available for consumption, or cash on hand ($X_{it} = [1 + (1-\tau) r] A_{it} + (1-\tau) wY_{it} + T$), thus:

$$\begin{aligned} X_{it+1} &= [1 + (1-\tau) r] A_{it+1} + (1-\tau) wY_{it+1} + T \\ &= [1 + (1-\tau) r] (X_{it} - C_{it}) + (1-\tau) wY_{it+1} + T \end{aligned}$$

Labor income risk is non-diversifiable and therefore affects households' consumption paths. Idiosyncratic labor productivity for household i follows the process:

$$\ln Y_{it} = \varphi \ln Y_{it-1} + \varepsilon_{it} \tag{1}$$

where φ is close to a unit root.[8]

[7] Allowing the borrowing limit to vary exogenously, or changing the government debt, does not affect the qualitative comparative statics of varying the tax rate.

[8] A large literature in applied labor economics on earnings dynamics either assumes that there exists a unit root in individual earnings (see Abowd and Card, 1989, and MacCurdy, 1982) or cannot reject the hypothesis of a unit root (see Meghir and Pistaferri, 2001). We do not follow this approach in this paper for two reasons. First, unit root tests in short panels can have low power; discriminating between a very persistent process

Recall we assume that government policies are exogenous and constant over time. Hence all economic agents solve their individual consumption problem given the tax rate and prices. Prices are determined endogenously to equilibrate asset supply and the demand for capital. We compute the joint distribution of wealth and labor income (rather than using simulations of individual life histories) and present these distributions later on in the paper.

2.2 Implications of Varying Tax Rates

Each time period is a year. We use a CRRA coefficient equal to 3 and $\alpha = 0.36$, so that the labor share in production is about $\frac{2}{3}$. The marginal tax rate ranges from zero to forty percent in five-percent intervals. The standard deviation of the earnings shocks, σ_{ε}, is 0.1. The depreciation rate of capital is eight percent and the discount rate five percent. The persistence in earnings is 0.92.[9]

The results for some of the variables of interest are presented in Figures 1-9. Higher taxation leads to a lower equilibrium saving rate for the economy (Figure 1), a higher gross (and net) interest rate (Figure 2), a lower capital stock (Figure 3) and output and a higher

and a unit root might not be possible. Second, most of the general equilibrium literature with this model uses an AR(1) process (see Aiyagari (1994), Floden (2001) and Domeij and Heathcote (2002), for instance). For comparability reasons, we choose a model as close as possible to this specification.

[9] We use a seven point approximation and a quadrature method to take expectations (see Burnside (1999) for a clear exposition of the practical issues involved). We use 100 grid points for the endogenous state variable (cash on hand) and ensure that the maximum value of cash on hand is always higher than the maximum possible cash on hand implied by the model (this is done by trial and error). We compute the time invariant distribution of cash on hand explicitly (rather than using Monte Carlo simulations). Cubic spline interpolations are used to interpolate between grid points.

level of transfers (Figure 4). These results capture the distortionary effects of higher taxation. The distortionary effects of higher taxes can also be seen in Figure 5 that illustrates how mean log consumption (μ) falls quite quickly with higher taxes. On the other hand, the dispersion (standard deviation, σ) of log consumption in the economy falls (Figure 6); this is the redistributive effect of higher transfers. Moreover, the ratio of the two (relative dispersion=$\frac{\sigma}{\mu}$) falls (Figure 7), implying that the fall in mean consumption is slower than the fall in the standard deviation of consumption.

To compare welfare we calculate the proportion of consumption that needs to be given up in each state of the world at any particular tax rate, for households to be indifferent between the actual tax rate and having zero taxes. Figure 8 shows that the 'most efficient' tax rate for our calibration is 16 percent, and agents would be indifferent between losing around 2.1 percent of consumption in each state of the world and moving from zero taxes to 16 percent taxes. The figure also highlights that utility is higher than the zero tax rate economy for any tax rate under around 36 percent. Figure 9 illustrates more clearly what happens to the unconditional wealth distribution when taxes are raised. The reduction in inequality is clearly illustrated: the wealth distribution is always compressed with higher taxes and transfers.

Figures 1-9 highlight that redistributive taxes can improve welfare if taxes are not too high, since the insurance effect will dominate the distortionary effect. But at higher tax rates the distortionary effect will dominate, reducing welfare. These turning points will depend on the parameters of the model. Our conclusions are robust to varying the structural parameters of the model. As a general rule, varying structural parameters that increase the value of risk-sharing (such as more earnings persistence or higher risk-aversion) increases the value of redistributive taxation. However higher risk-sharing takes place at the cost of increased production distortions which reduces mean consumption.[10]

3 Data

The simple theoretical model illustrates the effects of taxes on the first two consumption moments. Our empirical analysis explores this further, but first we describe the data. Household consumption is measured using the Consumer Expenditure Survey (CEX): a survey of US households that has operated on a continuous basis since 1980 and has detailed information on consumer expenditure and saving. 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 individual components of consumption, as well as a variety of household characteristics. It also includes the state of residence.[11] 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 are replaced by a new household. Since the survey records detailed information on each individual expenditure item, we can construct a measure of non-durable consumption that includes food and beverages, tobacco, housekeeping services, fuel, public utilities, repairs, public transport, personal care, entertainment,

[10] Krusell and Smith (1998) and Carroll (2000) argue that differences across agents in their rate of time preference better matches the observed US wealth distribution. Our theoretical results are robust to allowing heterogeneity in discount rates.

[11] For confidentiality reasons, state information is sometimes suppressed.

clothing and books, each deflated by the appropriate price index. We restrict the sample to those households for which full state information is available, that were interviewed between 1982-1998 and where the head is between the ages of 25 and 55. Furthermore, self-employed and farming households have been excluded. This results in a sample of around 100,000 households.

Information on household level income and transfers is obtained from the March supplement of the Current Population Survey (CPS). This is a Census survey also run by the BLS and designed to give very detailed and accurate information on income and demographics. Income is defined as total household labor income. We use income data from the CPS because it has the advantage of being a much larger survey than the CEX. Another advantage is that the errors with which income and consumption are measured are likely to be correlated when they are taken from the same survey while this is less likely when they come from different surveys.[12]

3.1 Household Taxes

Constructing a measure of the tax system in each state is not trivial and entails addressing a number of problems. We concentrate on income tax, which is raised at both the federal and state level.[13] Income tax systems can be quite complicated, and vary considerably across

[12]Correlated errors on the LHS and RHS in the regression will bias the regression, and the direction of this bias can not be determined *a priori*.

[13]US households are subject to many different taxes (including income taxes, sales taxes, property taxes and duty) levied at the federal and state levels, by county administrations, and by schoolboards. We concentrate on income tax, which is raised at both the federal and state level: our identification strategy exploits variation across, but not within, states. Specifically, property taxes and sales taxes are largely levied

jurisdictions. Table 1 illustrates the complexity of the federal income tax system in 1998: the federal marginal tax rate varies non-linearly from 15 percent for single people whose income is less than $26,250 ($43,850 for married couples) up to 39.6 percent for incomes over $288,350. Furthermore, these tax rates and tax brackets have all changed over the years. Before 1987 a much larger number of tax brackets was applicable, while before 1996 around 15-20 percent of people had incomes that were not sufficiently high for them to pay any federal income tax.

Table 2 shows that state marginal tax rates and exemptions differ widely between states. It shows that several states, including Texas and Florida, do not levy any income tax on their residents while New Hampshire and Tennessee only charge tax on dividend and interest income. The other states have a variety of income tax bands and exemptions (or tax credits) that are applicable. Although some states, such as Massachusetts and Illinois, have a flat rate income tax, in most states, the marginal tax rate increases with income. The difference between the highest and lowest marginal tax rate can sometimes be large. In Iowa the lowest marginal tax rate is 0.36 percent and the highest is 8.98, while several states have marginal tax rates even higher for the highest earning households. There are also, typically, a variety of tax allowances to which households are entitled. While there is no tax exempt income in Pennsylvania, up to $24,000 of income is exempt from state income tax in Connecticut for

at the county/schoolboard/city level which makes it problematic to construct a state level tax measure as the taxes vary substantially within each state. Moreover, sales taxes are paid at the place of sale rather than residence, making it difficult to measure the sales taxes levied on households within the state if cross-border shopping takes place. In the CEX, the spending figure excludes sales taxes, which makes expenditure comparable across states.

married couples. However, Connecticut allows no exempt income for other dependents, in contrast to Minnesota which allows the same exempt level of income for the earner, their partner, and each other dependent.

To measure how much redistribution there is through the tax system, information on transfers is also required; this comes from the CPS. Such transfers include 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: the CPS asks questions on all these transfers. Table 3 shows that the average transfer over the whole sampled population amounts to $994, while 22.6 percent of households receive some sort of transfer. Conditional on receiving at least something, households receive an average of $4,389. This should be compared to the average household salary in the survey of $34,281, or $19,483 for those households that are receiving transfers. While this amount may seem small, for some households it can make a substantial difference to their after tax (and transfer) income.

To construct each household's income tax burden, we exploit the TAXSIM 4.0 program developed by Freenberg (see Freenberg and Coutts, 1993, for details) which is provided by the NBER.[14] The output of the TAXSIM program allows us to measure of how redistributive the tax system is in each state. If the marginal tax rate was the same for all households in

[14]Using 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 dependant children) and other deductibles (like property costs) as well as the year and state of residence, the program calculates both the state and the federal tax bracket, tax liability, and marginal tax rate for each household in the sample, explicitly controlling for a variety of allowances.

a year and state, then this would be the natural measure of redistributiveness. However, as we saw earlier, marginal taxes differ substantially across agents even within the same year and state. Furthermore, agents have many exemptions, allowances, and transfers available to them that depend upon their household characteristics. Rather than explicitly model all the different effective marginal taxes (and transfers) that are available, we will instead reduce the problem to constructing an index that reflects the "average" marginal tax rate in each state. While a simplification, this will allow us to concentrate on how variation in redistribution through taxes and transfers affects consumers.

3.2 Measuring Redistributiveness

No completely satisfactory measure of redistributiveness exists, but some measures are possible given the output provided by the TAXSIM program. An obvious one is to compute the average marginal tax rate within each year t and state j. This is calculated as the mean of the household marginal tax rates obtained from the TAXSIM program. As table 4 shows, the average federal bracket is 20.2 percent, and the average marginal tax rate (which accounts for various allowances) is 19.2 percent. The state rates shown in the table vary from zero in Texas and Florida, which charge no income tax, to an average marginal tax rate of 7.4 percent in New York.

This measure, however, accounts neither for transfers nor for heterogeneity amongst household tax rates. For instance, a mean marginal tax rate of 20 per cent in a state could be due to all households paying a marginal tax rate of 20 per cent; to the bottom fifth of the population paying 100 percent and the rest nothing; or to the top 20 per cent paying 100 percent and the rest nothing. These three cases have substantially different implications for redistribution. Hence we also construct a more direct measure of how much the tax system compresses or redistributes income. This "income compression" measure is defined as:

$$1 - \frac{sd_{jt}\left(\text{income}_{ijt} - \text{tax liability}_{ijt} + \text{transfers}_{ijt}\right)}{sd_{jt}(\text{income}_{ijt})} \tag{2}$$

where the tax liability is obtained from the TAXSIM program, and i denotes the household. The above measure is computed for households that reside in a given state j in a given year t as one minus the ratio of the standard deviation of income after tax and transfers to the variance of income before tax and transfers. If all households faced the same marginal tax rate, and there were no allowances, then this measure would exactly equal the marginal (and average) tax rate, and it would not matter which measure was used. Given that the mean marginal tax rate conceal large differences in the households' marginal tax rates, the income compression measure will be our preferred measure of redistribution through the tax system.

Table 4 displays the two tax measures for the whole of the US and for six of the largest US states. The first column shows that the average marginal federal tax rate is 19.2 percent and that the average marginal state tax goes from 2.2 in Pennsylvania to 6.3 in New York. The last column of Table 4 reports the income compression measure, which averages 28.3 percent over the whole US, but differs from 22.8 percent in Florida (where there is no income tax), to 33.0 percent in New York, traditionally viewed as one of the more progressive states. This means that the tax and transfer system is 50 percent more redistributive in New York than in Florida. Taken together, these numbers show that there is enough variation across states to get meaningful results, a key issue if we are to convincingly assess the model predictions. Results will be reported for both measures (the correlation is 0.81 between the two measures).

4 The Empirical Evidence

The substantial variation of tax regimes across US states and over time we discussed in the previous section allows us to show how the mean and standard deviation are related to redistribution of consumption through the tax system. The regressions use year-state level grouped data where the measures of tax redistribution vary over time and across states. Cells are defined for each state for every two years: the minimum cell size was 50 households. Putting two years together allows more states to be included in the regressions given the minimum cell size of 50. In choosing the cell size we face a trade-off: choosing a higher number of households in each cell implies fewer observations in the regression leading to higher standard errors whereas a smaller cell size generates a larger number of observations in the regression but increases the within cell measurement error. Setting the cell size to 50 may seem low, but for many states there are few observations: this choice leaves 34 states to be included in the regressions with a total number of 227 observations.[15]

Throughout we refer to the mean and standard deviation of consumption as the mean and standard deviation of log consumption in each cell. The ratio of the standard deviation to the mean of consumption is defined as the relative dispersion or coefficient of variation of consumption. All these variables were regressed on the two different measures of tax redistributiveness. To control for observed heterogeneity at the household level, the following procedure was adopted: in the first stage household consumption was regressed against a

[15]Using different cell sizes, or combining one, or three years together, does not qualitatively change the results. We also experimented with trimming out the households with the highest and lowest level of consumption, which again does not quantitatively change the results. We omit reporting these other results in the tables for brevity.

cubic polynomial in age, education, family-size, month, year, race, and marital status. Group averages were then constructed from the residuals.[16]

4.1 Mean Consumption

Table 5 shows the results using mean consumption as the dependent variable. The first column includes a full set of state dummies in the regression. However, while the effect is as predicted by the theory, the estimated results are marginally not significant at the 10 percent level in both panel A (which reports results for our preferred measure of redistribution through the tax system) and in panel B which reports results for the mean marginal tax rate. The size of the effect shows that if the marginal income tax rate (or rather, the equivalent redistributive measure) were reduced by 10 percent then there is a 1.8 fall in mean consumption in panel A and a 1.5 percent decrease in panel B. A 10 percent difference is roughly the difference between Texas and New York. This difference seems small.

Column (2) includes a set of year dummies in the regression, and it shows that mean consumption decreases as the degree of taxes redistributivness increases, and the result is significant at the 5 percent level for our preferred measure. Moreover, the estimated coefficient is much larger. In columns (3) and (4) we have first differenced the data, which will remove any fixed differences across states. Column (4), which includes state fixed effects in the differenced regression, allows for the growth rate of mean consumption to be different across states. The results in columns (3) and (4) are very similar. The coefficients are again negative, and significant (at the 1 percent level) in panel A. These results suggest that a 10

[16] Omitting these first stage controls did not substantially change the results.

percent more redistributive tax system is reducing mean consumption by around 10 percent. While the estimated effect is smaller and not significant in panel B (it is around 1.5 percent), we believe this is due to the weakness of this tax measure in measuring redistribution.

4.2 Controlling for Potential Endogeneity:

Columns (1)-(4) in Table 5 report the current tax system regressed against the current level of consumption. However, in part they may be co-determined. For example, a high income shock to the state would result in estimated mean consumption to be higher, and is likely to change the measure of tax redistribution. This is likely to bias the results. It would be useful to look at a measure of the expected tax system where the expectation depends on the effectiveness of the state administration in raising tax revenue, and the likely taste for redistribution of the local residents in the state. We accomplish this by instrumenting the tax system with a set of lagged political variables, and two measures of tax efficiency.

Political variables are candidate instruments since they are likely to reflect attitudes towards redistribution, rather than general economic conditions. The political instruments used are the relative percent of votes for the republican candidate in presidential elections; whether the state governor was a democrat or republican, and who controlled the state legislature.[17] The instruments also include a measure of the tax raising ability, or 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

[17]The data were made available by Tim Storey at the National Conference of State Legislatures.

it was necessary to linearly interpolate the two series for some years. A full discussion of these variables is contained in these two references.

Columns (5)-(7) in Table 5 investigate the effect of using the instruments. For both tax measures, the rank test is significant in columns (5) and (6), which use state dummies, and use state and year dummies, but fails in column (7) where the data is differenced. Moreover, the Sargan test does not reject the over-identifying restrictions for the income compression measure (panel A), and only rejects the mean marginal tax rate measure (panel B) when the data are differenced (at least at the 10 percent level). Combining the rank and Sargan tests suggests that the political variables are suitable instruments for a regression of the tax measure on mean consumption, at least in levels. The results for levels show that the effect is not only negative for both measures of the tax system, but also significant at the 1 percent level when state dummies only are included, and at the 5 percent level when year dummies are added. When the data are differenced, the results in panel A (using the income compression measure) remain significant at the 10 percent level. Overall, the results strongly support the hypothesis that a more redistributive tax system does result in lower average consumption. The result in column (5) suggests a 10 percent reduction in income tax (using the redistribution measure) reduces mean consumption by 8.5 percent.

4.3 Standard Deviation of Consumption

Results for the standard deviation of log-consumption are reported in Table 6. In the first two columns in panel A, which used our preferred measure of how redistributive the tax system is, the estimated coefficient in the regression is not significant, and in column (2), which includes both state and year dummies in the regression, is even positive. The estimated effect in column (1) suggests that a 10 percent reduction in income tax rates (using the redistributive measure) reduces inequality by one percent. Using the mean marginal tax rate, the estimated coefficient is not significant when only state dummies are used, but is significant at the 10 percent level if year dummies are also included. Columns (3) and (4) first difference the data to remove any fixed state effect in the amount of inequality in each state. For our preferred measure of the tax system, the estimated coefficient is larger, and is significant at the 5 percent level. Similarly, the results are also negative and significant at the 5 percent level in panel B, which used the mean marginal tax rate. Both tax measures suggest that, as we would expect, redistribution through the tax system reduces cross-sectional inequality within the state.

The final three columns show the effect of instrumenting. The rank test suggests that the the instruments are not appropriate in column (7). The Sargan test of the over-identifying instruments is not rejected in Panel A in columns (5) and (6), but is rejected at the 10 percent level in Panel B. This suggests that we have good instruments for the income compression measure, but not for the mean marginal tax rate for this regression. Nevertheless, the IV-regression results show that all six estimated coefficients are negative. Moreover, when state effects only are included in column (5), the results are significant at the 5 percent level for both tax measures. The results in panel A suggests that half the difference in inequality between states can be explained by differences in how redistributive the tax system is. The results remain significant at the 10 percent level for the income compression measure when year effects are also included, or when the data are differenced (although again there is a large increase in the estimated coefficient). Overall the results suggest that making the tax system more redistributive substantially reduces the standard deviation of consumption, or cross-sectional variability, as we would expect.

4.4 Coefficient of Variation

Tables 5 and 6 show that both the mean and the variance of consumption are reduced when the tax system is more redistributive, at least for our preferred measure, and in our preferred results. The ratio of these variables is investigated in table 7. The results are broadly in line with those reported in table 6. In the first two columns the estimated effect is never significant in panel A, using our preferred measure of the tax system, but is significant at the 10 percent level in the second column when the regression uses the mean marginal tax rate. In columns (3) and (4), in which the data is first differenced, the estimated coefficient is larger in absolute sign, and is now significant (at the 10 percent level in the third column, and at the 5 percent level in the fourth column). However, it is not significant when we use the mean marginal tax system in the regression.

When the tax system is instrumented in columns (5)-(7), the results of the Sargan test are the same as in Table 6: the Sargan test rejects the over-identifying restrictions in columns (5) and (6) for Panel B. Combining these results with the rank test suggests that only Panel A, columns (5) and (6), can safely be interpreted. Nevertheless, all the IV-regressions estimate a negative effect on the coefficient of variation. In column (5), when state effects only are included in the regression, the results are significant at the 5 percent level in the top panel, and at the 10 percent level in Panel B. The results are no longer significant when year effects are included, column (6), while when the data are also differenced, the coefficients are only significant at the 10 percent level in Panel A. In column (6), where year dummies are included, the estimated coefficient is larger, but so is the standard deviation of the estimated coefficient, which means that it is not significant. Nevertheless, we are encouraged by the result in column (5) which shows that when taxes are reduced by 10 percent (roughly the difference between Texas and New York) the tradeoff is between a 10 percent reduction in mean consumption and a 50 percent reduction in inequality.

In our view these results are remarkable. Overall, the results show that the coefficient of variation falls as the tax system becomes more redistributive, and for our preferred measure this difference is always negative, and is significant if either the data is differenced, or if the tax system is instrumented as in column (5). Moreover, we know that the mean marginal tax rate is not a good measure of how much redistribution there is through the tax system, and this is confirmed by the results, which for the most part are not significant (although they do have the same sign, in most cases as our preferred measure of the tax system). As we saw in the theory section, in the presence of idiosyncratic risk, there is both an insurance and a distortionary effect of redistributive taxes. In the model, the insurance effect was sufficiently strong for the coefficient of variation to fall with taxes, and this insight is confirmed by the results in Table 7.

5 Conclusions

This paper first shows that existing macro models of idiosyncratic risk imply a strong insurance effect of redistributive tax and transfer policies, as well as the standard distortionary effect. The first effect is captured by a negative relationship between taxes and the standard deviation of consumption for any cross-section of households in the economy. The second effect is shown by a negative relationship between taxes and mean consumption. We show that such models typically imply a drop in the coefficient of variation of consumption as taxes become more redistributive, indicating a rather strong insurance effect of taxes.

We then use US-state data in order to test for these effects of taxation on the consumption distribution. We exploit the high variation of taxes across states and over time; using state data is a natural test and avoids some of the difficulties in exploiting differences across countries. Nevertheless, the empirical analysis controls for some of the differences between US states that might otherwise contaminate the results: we include state and time dummies in the regression; we difference the data to remove any state fixed effects; and we instrument the tax system using political and other variables. We find that both the distortionary and the insurance effect on consumption are present, as there is a negative correlation between taxes and the mean and standard deviation of consumption. Our preferred estimate (using the income compression measure) shows that a 10 percent reduction in the tax rate reduces mean consumption by 10 percent, but can explain half the difference in within state consumption inequality across US states in our sample.[18]

Interestingly, we also find a negative correlation between taxes and the coefficient of variation of consumption across states. Together with the result on the standard deviation of consumption, this indicates the presence of a robust insurance effect of marginal taxation in the data. If redistributive policies are not compressing an income process that includes

[18] Since we sample households aged between 25 and 55, we have already removed the differences in inequality between states caused by demographic differences.

idiosyncratic risk, then it is difficult to explain why we observe a negative effect of redistributiveness on the standard deviation of consumption when we do not control for the standard deviation of pre-tax income. Our study thus suggests that the insurance effect must be present.

Our main conclusion is that the insurance effect of taxes is a non-trivial consideration for policy analysis and that researchers should address it together with the distortionary effects in carefully calibrated macro models of idiosyncratic risk. That is, insuring idiosyncratic risk is indeed a key concern in the construction of optimal policies. Papers such as those of Aiyagari and McGrattan (1998), Floden (2001), Domeij and Heathcote (2002), and Conesa, Kitao and Krueger (2006), thus stress an important issue in the evaluation of policies financed through marginal income taxes.

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Table 1: Income thresholds for current 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 refers to 1998 and is available from 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.

Table 2: State Individual Income Tax Rates in the US

State	Tax Rates low	Tax Rates high	Exemptions single	Exemptions married	Exemptions dependents
Alabama	2.0	5.0	1,500	3,000	300
Alaska	no state tax				
Arizona	2.87	5.04	2,100	4,200	2,300
California	1.0	9.3	72*	142*	227*
Colorado	4.63	4.63		none	
Florida	no state tax				
Georgia	1.0	6.0	2,700	5,400	2,700
Illinois	3.0	3.0	2,000	4,000	2,000
Indiana	3.4	3.4	1,000	2,000	1,000
Kentucky	2.0	6.0	20*	40*	20*
Louisiana	2.0	6.0	4,500	9,000	1,000
Maryland	2.0	4.75	1,850	3,700	1,850
Massachusetts	5.6	5.6	4,400	8,800	1,000
Michigan	4.2	4.2	2,800	5,600	2,800
Minnesota	5.35	7.85	2,900	5,800	2,900
Mississippi	3.0	5.0	6,000	12,000	1,000
Missouri	1.5	6.0	2,100	4,200	2,100
Nevada	no state tax				
New Jersey	1.4	6.37	1,000	2,000	1,500
New York	4.0	6.85	-	-	1,000
North Carolina	6.0	7.75	2,500	5,000	2,500
Ohio	0.691	6.98	1,050	2,100	1,050
Oklahoma	0.5	6.75	1,000	2,000	1,000
Pennsylvania	2.8	2.8		none	
South Carolina	2.5	7.0	2,900	5,800	2,900
Tennessee	taxes unearned income only				
Texas	no state tax				
Virginia	2.0	5.75	800	1,600	800
Washington	no state tax				
Wisconsin	4.6	6.75	700	1,400	400

*Refers to Tax Credits rather exempt income. The data refers to 1998 and is available from the Federation of Tax Administrators at 444 N. Capital Street, Washington DC. The 'min.' and 'max.' refers to the minimum and maximum tax bracket in the state, 'single' and 'married' refer to single filers and households in which the husband and wife jointly file, while 'dependents' refer to each additional dependent person for which the file may claim.

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

	average	average if received	% receive
wages	32,950	34,281	96.1
social security	272	6,944	3.9
supplementary security income	73	4,339	1.6
unemployment/workers compensation	378	2,766	13.6
public assistance / welfare	166	4,216	3.9
food stamps	104	1,521	6.8
total transfer	994	4,389	22.6

Data is constructed from reported responses in the March supplement of the CPS for the years 1982-1998. 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: Measuring tax redistributiveness by state:

	marginal rate	tax bracket	income compression
Federal	19.2	20.2	
State:			
Overall	3.7	4.2	27.7
California	5.0	5.3	30.3
Florida	0	0	22.5
New York	6.3	7.4	32.6
Ohio	3.8	4.0	28.4
Pennsylvania	2.2	2.4	26.8
Texas	0	0	22.8

Data is constructed using income from the March supplement of the CPS for 1982-1998, 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).

Table 5: The effect of taxes on mean log-consumption.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A:							
tax rate	-0.177	-0.706	-1.071	-1.145	-0.857	-3.547	-3.951
	(0.110)	(0.318)	(0.354)	(0.395)	(0.284)	(1.522)	(2.226)
p-value	0.111	0.028	0.003	0.004	0.003	0.021	0.078
constant	7.195	7.385	0.020	-0.171	7.659	8.530	-0.127
	(0.066)	(0.123)	(0.014)	(0.023)	(0.090)	(0.460)	(0.100)
Sargan test					4.471	4.764	4.457
p-value					(0.484)	(0.445)	(0.486)
Rank test					8.36	11.24	1.12
p-value					(0.000)	(0.000)	(0.353)
Panel B:							
tax rate	-0.146	-0.305	-0.186	-0.148	-0.610	-1.896	-0.807
	(0.090)	(0.329)	(0.300)	(0.436)	(0.200)	(0.800)	(3.713)
p-value	0.105	0.355	0.641	0.735	0.003	0.019	0.828
constant	7.173	7.228	0.012	-0.190	7.590	8.026	-0.194
	(0.062)	(0.106)	(0.014)	(0.022)	(0.075)	(0.243)	(0.088)
Sargan test					5.068	7.311	9.999
p-value					(0.408)	(0.198)	(0.075)
Rank test					2.42	8.51	1.18
p-value					(0.038)	(0.000)	(0.323)
Dummies:							
state	yes	yes		yes	yes	yes	yes
year		yes	yes	yes		yes	yes
diff.			yes	yes			yes
instr.					yes	yes	yes

Panel A refers to regressions involving the ratio of the standard deviation of after tax income to the standard deviation of before tax income, while Panel B refers to using the mean marginal tax rate. Here *state* refers to the inclusion of state dummies, *year* refers to the inclusion of year dummies, *diff.* refers to whether the data was first-differenced, while *instr.* refers to instrumenting the tax system. All regressions control for household characteristics. The cell size was 50. Huber standard errors are reported in parenthesis.

Table 6: The effect of taxes on the standard deviation of log-consumption.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A:							
tax rate	-0.055	0.043	-0.756	-0.851	-0.461	-1.890	-3.267
	(0.084)	(0.237)	(0.362)	(0.370)	(0.209)	(1.106)	(1.786)
p-value	0.509	0.855	0.038	0.023	0.028	0.089	0.069
constant	0.514	0.477	0.038	0.040	0.596	1.052	0.078
	(0.050)	(0.092)	(0.011)	(0.017)	(0.066)	(0.334)	(0.080)
Sargan test					8.961	4.499	5.310
p-value					(0.111)	(0.480)	(0.379)
Rank test					8.36	11.24	1.12
p-value					(0.000)	(0.000)	(0.353)
Panel B:							
tax rate	-0.106	-0.467	-0.032	-0.181	-0.307	-0.555	-2.834
	(0.068)	(0.240)	(0.376)	(0.391)	(0.145)	(0.551)	(3.250)
p-value	0.119	0.053	0.931	0.643	0.036	0.315	0.384
constant	0.517	0.613	0.032	0.026	0.555	0.651	0.010
	(0.046)	(0.077)	(0.011)	(0.017)	(0.054)	(0.167)	(0.077)
Sargan test					10.656	9.945	8.620
p-value					(0.059)	(0.077)	(0.125)
Rank test					2.42	8.51	1.18
p-value					(0.038)	(0.000)	(0.323)
Dummies:							
state	yes	yes		yes	yes	yes	yes
year		yes	yes	yes		yes	yes
diff.			yes	yes			yes
instr.					yes	yes	yes

Panel A refers to regressions involving the ratio of the standard deviation of after tax income to the standard deviation of before tax income, while Panel B refers to using the mean marginal tax rate. Here *state* refers to the inclusion of state dummies, *year* refers to the inclusion of year dummies, *diff.* refers to whether the data was first-differenced, while *instr.* refers to instrumenting the tax system. All regressions control for household characteristics. The cell size was 50. Huber standard errors are reported in parenthesis.

Table 7: The effect of taxes on the coefficient of variation of log-consumption.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A:	*tax rate*	-0.045	0.090	-0.689	-0.779	-0.412	-1.683	-3.001
		(0.083)	(0.236)	(0.357)	(0.364)	(0.206)	(1.080)	(1.727)
	p-value	0.586	0.704	0.055	0.034	0.047	0.121	0.084
constant		0.518	0.468	0.037	0.049	0.571	0.976	0.085
		(0.050)	(0.091)	(0.011)	(0.017)	(0.065)	(0.326)	(0.078)
	Sargan test					9.245	4.992	5.749
	p-value					(0.100)	(0.417)	(0.331)
	Rank test					8.36	11.24	1.12
	p-value					(0.000)	(0.000)	(0.353)
Panel B:								
	tax rate	-0.099	-0.452	-0.015	-0.168	-0.272	-0.446	-2.761
		(0.067)	(0.239)	(0.374)	(0.387)	(0.143)	(0.550)	(3.181)
	p-value	0.145	0.061	0.966	0.664	0.060	0.418	0.387
	constant	0.523	0.616	0.032	0.036	0.534	0.604	0.021
		(0.046)	(0.077)	(0.011)	(0.016)	(0.053)	(0.167)	(0.075)
	Sargan test					10.763	9.769	8.435
	p-value					(0.056)	(0.082)	(0.134)
	Rank test					2.42	8.51	1.18
	p-value					(0.038)	(0.000)	(0.323)
Dummies:								
	state	yes	yes		yes	yes	yes	yes
	year		yes	yes	yes		yes	yes
	diff.			yes	yes			yes
	instr.					yes	yes	yes

Panel A refers to regressions involving the ratio of the standard deviation of after tax income to the standard deviation of before tax income, while Panel B refers to using the mean marginal tax rate. Here *state* refers to the inclusion of state dummies, *year* refers to the inclusion of year dummies, *diff.* refers to whether the data was first-differenced, while *instr.* refers to instrumenting the tax system. All regressions control for household characteristics. The cell size was 50. Huber standard errors are reported in parenthesis.

Single discount factor economy (rho=3)

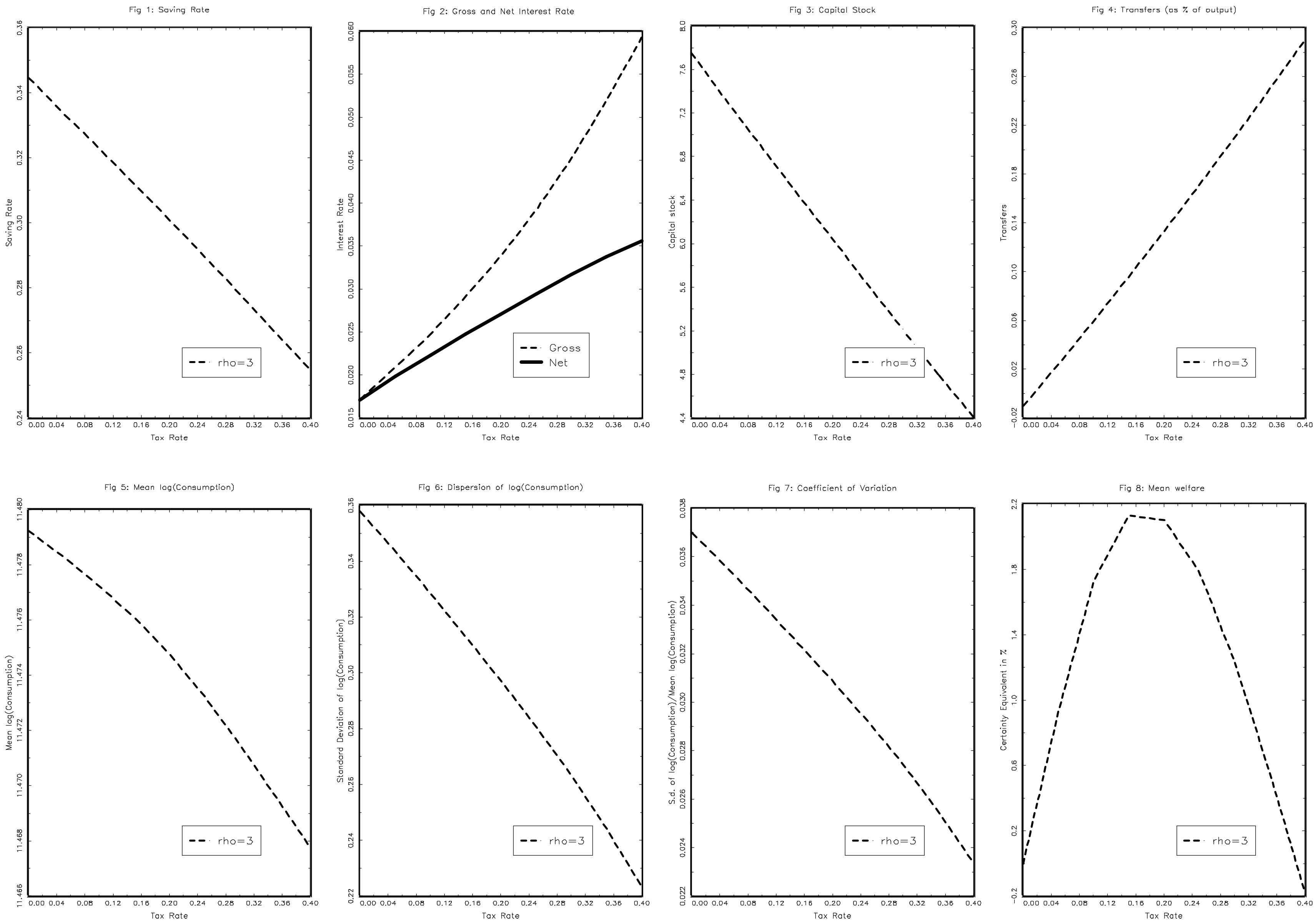
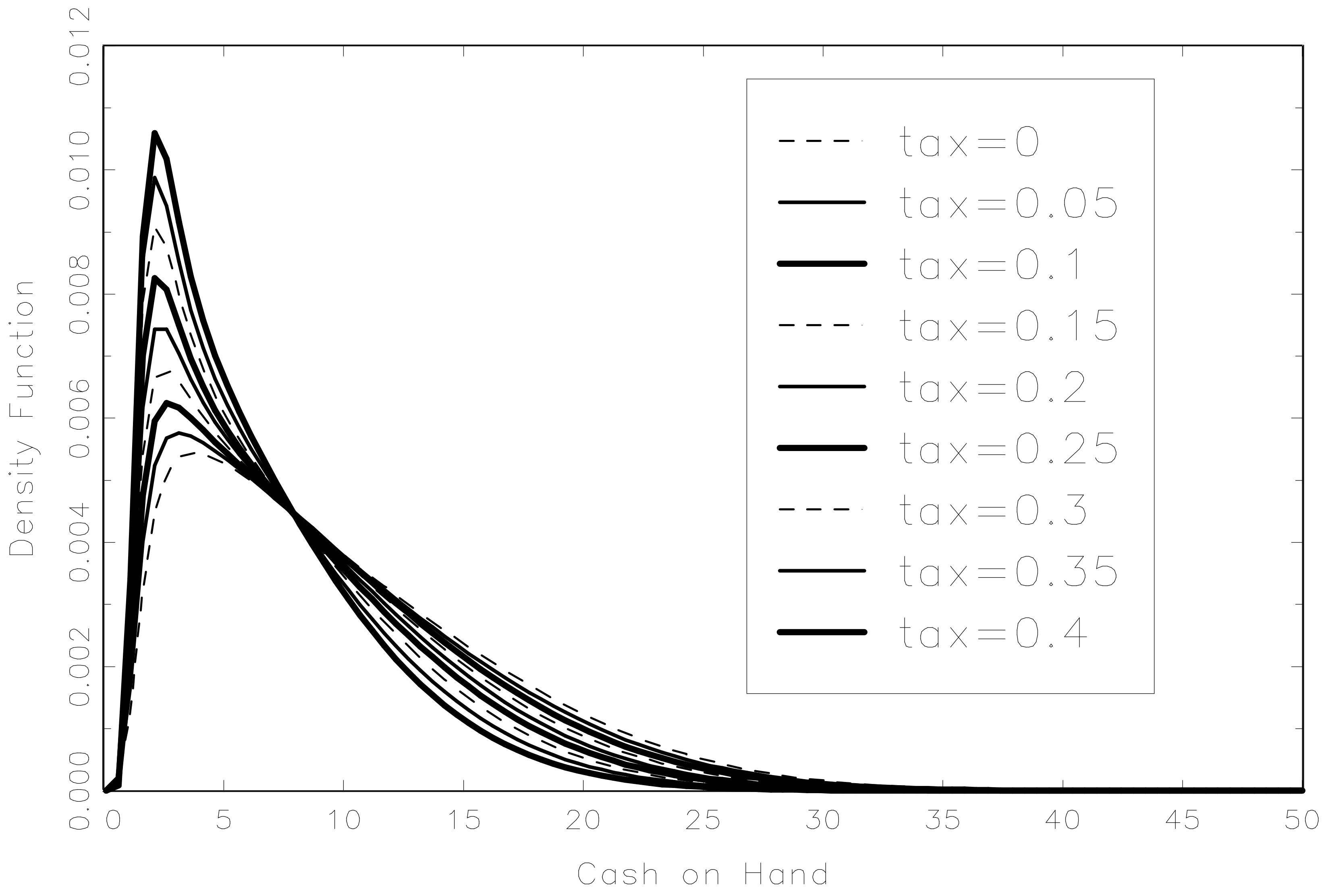


Fig 9: Unconditional Cash on Hand Distributions varying taxes (rho=3)



WORKING PAPERS

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Evidence on the Insurance Effect of Redistributive Taxation

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Abstract

We show that redistributive tax and transfer systems have a distortionary effect and an insurance effect, if agents face idiosyncratic uninsurable earnings risk. These two effects imply that redistributive taxes decrease both mean consumption and the standard deviation of consumption. Using household data, we construct an 'income compression' measure of the redistributiveness of the tax system and empirically test for the presence of these two effects by exploiting differences in US state taxes. We find that tax redistributiveness explains much of the variation in the mean and standard deviation of the within-state consumption distributions over the US. This provides evidence for the presence of both distortionary and insurance effects of redistributive taxes and transfers.

JEL Classification: E21, H20, H31

Keywords: Undiversifiable Earnings Risk, Tax Distortions, Insurance

1 Introduction

Much analysis of household consumption focuses on the study of choices made by forward-looking wealth-accumulating agents who face exogenous idiosyncratic labor-income shocks and liquidity constraints.[1] This micro approach to consumption choice has been incorporated into workable applied macro models since the pioneering work by Bewley (1986), Huggett (1993) and Aiyagari (1994), taking macroeconomic analysis beyond the representative agent. Yet, the inclusion of idiosyncratic risk in a macro framework gave immediate rise to policy issues. Even in an economy with no externalities, due to market incompleteness, idiosyncratic risk cannot be insured, and hence the competitive equilibrium is not Pareto efficient. Liquidity constraints exist in equilibrium, and agents face the probability of not being able to smooth consumption through borrowing.[2]

The possibility for Pareto improvement in economies with idiosyncratic risk has led several authors to challenge the view that marginal taxes on capital and labor income, in the absence of externalities, always lead to welfare deteriorations.[3] In a macroeconomy with capital accumulation and idiosyncratic risk, redistributive taxes and transfers on capital and labor income are expected to have two distinct long-run effects on consumption: (i) they

[1]For example, Deaton (1991), Carroll (1997), Hubbard, Skinner, Zeldes (1995), and Gourinchas and Parker (2002) offer supporting evidence that some combination of precautionary saving and/or liquidity constraints can be important determinants of saving and consumption dynamics.

[2]This point is discussed in Aiyagari (1994).

[3]For example, Aiyagari (1995) extended the Chamley (1986) model to include idiosyncratic labor risk and showed that the *optimal* long-run marginal tax on capital is positive. More recently, Conesa, Kitao and Krueger (2006), argued that the optimal tax rate on capital should be 36% in an overlapping-generations model with idiosyncratic risk.

should decrease the observed long-run mean of consumption as marginal taxes reduce the incentives for saving and capital accumulation, and (ii) they should decrease the observed standard deviation of consumption across households, through decreasing the effective fluctuations of after-tax individual income.[4]

The traditional approach without idiosyncratic risk has emphasized the first or distortionary effect of taxes which reduces average consumption and reduces welfare. But if households face uninsured idiosyncratic risk there is also a second and countervailing insurance effect of redistributive taxes which reduces each household's consumption variability and raises welfare. The relative importance of these two effects is crucial for the evaluation of fiscal policy in macro models with idiosyncratic risk. Hence it is important to empirically test whether the distortionary and insurance effects of redistribution through the tax and benefit system can indeed be observed in the data. To test for these effects is therefore a main aim of our study.

Our analysis starts by simulating a benchmark model of idiosyncratic labor-income shocks that demonstrates the distortionary and the insurance effect of redistributive taxes (and transfers) on the stationary distribution of consumption. In models of this type, both the mean and the standard deviation of cross-sectional consumption fall when taxes rise. For plausible parameters, the insurance effect is sufficiently strong for the coefficient of variation to fall as taxes increase. Moreover, below some threshold (which depends on the parameters of the model) welfare improves as taxes increase since the insurance effect dominates, but

[4]Transfers can also relax liquidity constraints, which again increases consumption smoothing and reduces the need for precautionary saving.

welfare falls above this threshold point.[5]

The core of the paper is devoted to examining the empirical evidence on the effect of taxes and transfers on the mean, the standard deviation, and the coefficient of variation of consumption, and to quantifying this effect. We use data for different US states (treating each state as a small economy) to investigate the relationship within each state between redistribution through taxes and transfers, and the distribution of household consumption.

We utilize individual consumption data from about 100,000 American households from the Consumer Expenditure Survey (CEX), while we collect household income data from the Current Population Survey (CPS). We calculate the taxes paid by each individual using the TAXSIM program provided by the NBER. An important innovation of the paper is to construct a measure of redistribution through the tax system. Using the mean marginal tax rate and/or some aggregate measure of transfers has serious drawbacks (we discuss this further below). Our study uses data on each *household's* income before and after taxes to construct an income compression measure which more directly captures redistribution through taxes and transfers.

Using observations from different US states offers an appropriate 'laboratory' in which to test the empirical implications of the model since, as we show, variation in state-level taxes is substantial, allowing for a meaningful interpolative analysis. In contrast, cross-country variation may instead reflect differences in institutional, cultural and other country-specific features as well as differences in the measurement of the appropriate household level variables

[5]The insurance effect is exactly what gives rise to the study of second-best redistributive policies in the literature. This study does not investigate second-best taxation in a calibrated model, rather, it tests whether the insurance effect is found in the data.

in different surveys. These issues are likely to be much less important when comparing across US states. Moreover, using the same survey across tax regimes reduces the chance that differences in the survey design spuriously generate the different measured policy responses.

We provide evidence that redistribution through the tax and transfer system is negatively correlated with both the mean and the variance of consumption and quantify the size of these effects. We also find that the coefficient of variation of consumption distributions across US states is negatively correlated with redistributive income taxes, indicating a strong insurance effect. Finding evidence for the presence of an insurance effect of taxes on observed cross-sections of the consumption distributions has deeper implications than simply testing the impact of policy. It demonstrates a channel through which the effects of idiosyncratic risk on individual decisions are transmitted to the aggregate level. The insurance effect of taxes is important and demonstrable, hence it is important to stress the appropriate policy tradeoffs (between the distortionary and insurance effects) in models of taxes which incorporate idiosyncratic risk.

The structure of the paper is as follows. In Section 2 we calibrate a benchmark model economy with idiosyncratic risk and show how tax policies imply both a distortionary and an insurance effect on consumption. In Section 3 we describe the data and compare the tax system in different US states. We also propose two measures of tax redistributiveness in the different US states. Section 4 presents the empirical findings and Section 5 concludes.

2 Theoretical underpinnings

In this section we solve a heterogeneous-agent model à la Aiyagari (1994), extended to include an exogenous redistributive policy. We focus on the effects of different redistributive policies on consumption. We emphasize that the goal of this theoretical analysis is to demonstrate the presence of the two effects and not to conduct a comprehensive quantitative analysis of optimal policies.

2.1 The Model

Production of final goods takes place through a large number of identical firms that use capital and labor as inputs. All firms operate a common neoclassical production technology characterized by the Cobb-Douglas production function:

$$\mathbf{y} = F\left(\overline{\mathbf{K}},\ \overline{\mathbf{L}}\right) = \overline{\mathbf{K}}^{\alpha}\overline{\mathbf{L}}^{1-\alpha}$$

with $\alpha \in (0, 1)$. The function F is endowed with the usual neoclassical properties: diminishing marginal returns to each factor, constant returns to scale, and the Inada conditions. Competitive pricing implies that factors of production earn their marginal products:

$$R = F_1\left(\overline{\mathbf{K}}, \overline{\mathbf{L}}\right) \quad \text{and} \quad w = F_2\left(\overline{\mathbf{K}}, \overline{\mathbf{L}}\right)$$

Capital depreciates in each period at the constant rate δ, implying that the user cost is $r = R - \delta$.

We abstract from government spending on public goods, and any possible inefficiency in raising revenue and/or spending by governments, and concentrate solely on the redistributive aspect of taxes and transfers. Policies are exogenous and constant over time. The government imposes a fixed and pre-specified marginal tax rate τ on capital and labor income and redistributes the average tax revenues, T, to all individuals, after paying the interest cost of the steady state government debt, D_t. The government's balanced budget constraint in each period therefore becomes:

$$T_t + rD_t = \tau r\overline{\mathbf{K}}_t + \tau\overline{\mathbf{L}_t}$$

There are a large number of households that derive utility solely from the consumption of the final good. Each household receives an idiosyncratic labor income shock. Households can smooth their consumption profile via the trading of assets A_{it} in a capital market that is characterized by an (exogenous) borrowing constraint. The household pays taxes at rate τ on both capital and labor income, but receives a common per-capita lump-sum transfer T that is financed from this taxation.[6]

There is no aggregate uncertainty, but individuals face idiosyncratic labor income shocks, denoted by Y_{it}. In the stationary equilibrium, all resulting asymptotic distributions in the economy are time-invariant, even though there is substantial mobility at the individual level. Aggregate-economy prices are therefore constant, described by the price vector $\{r, w\}$.

The consumer's problem is:

$$\max E_0 \sum_{t=0}^{\infty} \beta^t u(C_{it})$$

s.t. (for all $t \in \{0, 1, ..\}$):

$$C_{it} + A_{it+1} = [1 + (1-\tau)\, r]\, A_{it} + (1-\tau)\, wY_{it} + T$$

[6]US tax jurisdictions rarely distinguish between these different sources of income when assessing the household's tax liability.

$$A_{it+1} \geq -b$$

where β is the constant discount factor, C_{it} is consumption for individual i at time t; b is the borrowing limit; and T is the per capita transfer. Our computations use the standard CRRA utility function.

$$u\left(C_{it}\right) = \frac{C_{it}^{1-\rho}}{1-\rho}$$

with $\rho > 0$.

The computations we report allow no borrowing ($b = 0$) and fix the government debt to be zero.[7] Moreover, following Deaton (1991) and Aiyagari (1994), it is convenient to work with the the total resources available for consumption, or cash on hand ($X_{it} = \left[1 + (1-\tau) r\right] A_{it} + (1-\tau) wY_{it} + T$), thus:

$$\begin{aligned} X_{it+1} &= \left[1 + (1-\tau) r\right] A_{it+1} + (1-\tau) wY_{it+1} + T \\ &= \left[1 + (1-\tau) r\right] (X_{it} - C_{it}) + (1-\tau) wY_{it+1} + T \end{aligned}$$

Labor income risk is non-diversifiable and therefore affects households' consumption paths. Idiosyncratic labor productivity for household i follows the process:

$$\ln Y_{it} = \varphi \ln Y_{it-1} + \varepsilon_{it} \qquad (1)$$

where φ is close to a unit root.[8]

[7] Allowing the borrowing limit to vary exogenously, or changing the government debt, does not affect the qualitative comparative statics of varying the tax rate.

[8] A large literature in applied labor economics on earnings dynamics either assumes that there exists a unit root in individual earnings (see Abowd and Card, 1989, and MacCurdy, 1982) or cannot reject the hypothesis of a unit root (see Meghir and Pistaferri, 2001). We do not follow this approach in this paper for two reasons. First, unit root tests in short panels can have low power; discriminating between a very persistent process

Recall we assume that government policies are exogenous and constant over time. Hence all economic agents solve their individual consumption problem given the tax rate and prices. Prices are determined endogenously to equilibrate asset supply and the demand for capital. We compute the joint distribution of wealth and labor income (rather than using simulations of individual life histories) and present these distributions later on in the paper.

2.2 Implications of Varying Tax Rates

Each time period is a year. We use a CRRA coefficient equal to 3 and $\alpha = 0.36$, so that the labor share in production is about $\frac{2}{3}$. The marginal tax rate ranges from zero to forty percent in five-percent intervals. The standard deviation of the earnings shocks, σ_ε, is 0.1. The depreciation rate of capital is eight percent and the discount rate five percent. The persistence in earnings is 0.92.[9]

The results for some of the variables of interest are presented in Figures 1-9. Higher taxation leads to a lower equilibrium saving rate for the economy (Figure 1), a higher gross (and net) interest rate (Figure 2), a lower capital stock (Figure 3) and output and a higher

and a unit root might not be possible. Second, most of the general equilibrium literature with this model uses an AR(1) process (see Aiyagari (1994), Floden (2001) and Domeij and Heathcote (2002), for instance). For comparability reasons, we choose a model as close as possible to this specification.

[9]We use a seven point approximation and a quadrature method to take expectations (see Burnside (1999) for a clear exposition of the practical issues involved). We use 100 grid points for the endogenous state variable (cash on hand) and ensure that the maximum value of cash on hand is always higher than the maximum possible cash on hand implied by the model (this is done by trial and error). We compute the time invariant distribution of cash on hand explicitly (rather than using Monte Carlo simulations). Cubic spline interpolations are used to interpolate between grid points.

level of transfers (Figure 4). These results capture the distortionary effects of higher taxation. The distortionary effects of higher taxes can also be seen in Figure 5 that illustrates how mean log consumption (μ) falls quite quickly with higher taxes. On the other hand, the dispersion (standard deviation, σ) of log consumption in the economy falls (Figure 6); this is the redistributive effect of higher transfers. Moreover, the ratio of the two (relative dispersion=$\frac{\sigma}{\mu}$) falls (Figure 7), implying that the fall in mean consumption is slower than the fall in the standard deviation of consumption.

To compare welfare we calculate the proportion of consumption that needs to be given up in each state of the world at any particular tax rate, for households to be indifferent between the actual tax rate and having zero taxes. Figure 8 shows that the 'most efficient' tax rate for our calibration is 16 percent, and agents would be indifferent between losing around 2.1 percent of consumption in each state of the world and moving from zero taxes to 16 percent taxes. The figure also highlights that utility is higher than the zero tax rate economy for any tax rate under around 36 percent. Figure 9 illustrates more clearly what happens to the unconditional wealth distribution when taxes are raised. The reduction in inequality is clearly illustrated: the wealth distribution is always compressed with higher taxes and transfers.

Figures 1-9 highlight that redistributive taxes can improve welfare if taxes are not too high, since the insurance effect will dominate the distortionary effect. But at higher tax rates the distortionary effect will dominate, reducing welfare. These turning points will depend on the parameters of the model. Our conclusions are robust to varying the structural parameters of the model. As a general rule, varying structural parameters that increase the value of risk-sharing (such as more earnings persistence or higher risk-aversion) increases the value of redistributive taxation. However higher risk-sharing takes place at the cost of increased production distortions which reduces mean consumption.[10]

3 Data

The simple theoretical model illustrates the effects of taxes on the first two consumption moments. Our empirical analysis explores this further, but first we describe the data. Household consumption is measured using the Consumer Expenditure Survey (CEX): a survey of US households that has operated on a continuous basis since 1980 and has detailed information on consumer expenditure and saving. 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 individual components of consumption, as well as a variety of household characteristics. It also includes the state of residence.[11] 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 are replaced by a new household. Since the survey records detailed information on each individual expenditure item, we can construct a measure of non-durable consumption that includes food and beverages, tobacco, housekeeping services, fuel, public utilities, repairs, public transport, personal care, entertainment,

[10] Krusell and Smith (1998) and Carroll (2000) argue that differences across agents in their rate of time preference better matches the observed US wealth distribution. Our theoretical results are robust to allowing heterogeneity in discount rates.

[11] For confidentiality reasons, state information is sometimes suppressed.

clothing and books, each deflated by the appropriate price index. We restrict the sample to those households for which full state information is available, that were interviewed between 1982-1998 and where the head is between the ages of 25 and 55. Furthermore, self-employed and farming households have been excluded. This results in a sample of around 100,000 households.

Information on household level income and transfers is obtained from the March supplement of the Current Population Survey (CPS). This is a Census survey also run by the BLS and designed to give very detailed and accurate information on income and demographics. Income is defined as total household labor income. We use income data from the CPS because it has the advantage of being a much larger survey than the CEX. Another advantage is that the errors with which income and consumption are measured are likely to be correlated when they are taken from the same survey while this is less likely when they come from different surveys.[12]

3.1 Household Taxes

Constructing a measure of the tax system in each state is not trivial and entails addressing a number of problems. We concentrate on income tax, which is raised at both the federal and state level.[13] Income tax systems can be quite complicated, and vary considerably across

[12]Correlated errors on the LHS and RHS in the regression will bias the regression, and the direction of this bias can not be determined *a priori*.

[13]US households are subject to many different taxes (including income taxes, sales taxes, property taxes and duty) levied at the federal and state levels, by county administrations, and by schoolboards. We concentrate on income tax, which is raised at both the federal and state level: our identification strategy exploits variation across, but not within, states. Specifically, property taxes and sales taxes are largely levied

jurisdictions. Table 1 illustrates the complexity of the federal income tax system in 1998: the federal marginal tax rate varies non-linearly from 15 percent for single people whose income is less than $26,250 ($43,850 for married couples) up to 39.6 percent for incomes over $288,350. Furthermore, these tax rates and tax brackets have all changed over the years. Before 1987 a much larger number of tax brackets was applicable, while before 1996 around 15-20 percent of people had incomes that were not sufficiently high for them to pay any federal income tax.

Table 2 shows that state marginal tax rates and exemptions differ widely between states. It shows that several states, including Texas and Florida, do not levy any income tax on their residents while New Hampshire and Tennessee only charge tax on dividend and interest income. The other states have a variety of income tax bands and exemptions (or tax credits) that are applicable. Although some states, such as Massachusetts and Illinois, have a flat rate income tax, in most states, the marginal tax rate increases with income. The difference between the highest and lowest marginal tax rate can sometimes be large. In Iowa the lowest marginal tax rate is 0.36 percent and the highest is 8.98, while several states have marginal tax rates even higher for the highest earning households. There are also, typically, a variety of tax allowances to which households are entitled. While there is no tax exempt income in Pennsylvania, up to $24,000 of income is exempt from state income tax in Connecticut for

at the county/schoolboard/city level which makes it problematic to construct a state level tax measure as the taxes vary substantially within each state. Moreover, sales taxes are paid at the place of sale rather than residence, making it difficult to measure the sales taxes levied on households within the state if cross-border shopping takes place. In the CEX, the spending figure excludes sales taxes, which makes expenditure comparable across states.

married couples. However, Connecticut allows no exempt income for other dependents, in contrast to Minnesota which allows the same exempt level of income for the earner, their partner, and each other dependent.

To measure how much redistribution there is through the tax system, information on transfers is also required; this comes from the CPS. Such transfers include 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: the CPS asks questions on all these transfers. Table 3 shows that the average transfer over the whole sampled population amounts to $994, while 22.6 percent of households receive some sort of transfer. Conditional on receiving at least something, households receive an average of $4,389. This should be compared to the average household salary in the survey of $34,281, or $19,483 for those households that are receiving transfers. While this amount may seem small, for some households it can make a substantial difference to their after tax (and transfer) income.

To construct each household's income tax burden, we exploit the TAXSIM 4.0 program developed by Freenberg (see Freenberg and Coutts, 1993, for details) which is provided by the NBER.[14] The output of the TAXSIM program allows us to measure of how redistributive the tax system is in each state. If the marginal tax rate was the same for all households in

[14]Using 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 dependant children) and other deductibles (like property costs) as well as the year and state of residence, the program calculates both the state and the federal tax bracket, tax liability, and marginal tax rate for each household in the sample, explicitly controlling for a variety of allowances.

a year and state, then this would be the natural measure of redistributiveness. However, as we saw earlier, marginal taxes differ substantially across agents even within the same year and state. Furthermore, agents have many exemptions, allowances, and transfers available to them that depend upon their household characteristics. Rather than explicitly model all the different effective marginal taxes (and transfers) that are available, we will instead reduce the problem to constructing an index that reflects the "average" marginal tax rate in each state. While a simplification, this will allow us to concentrate on how variation in redistribution through taxes and transfers affects consumers.

3.2 Measuring Redistributiveness

No completely satisfactory measure of redistributiveness exists, but some measures are possible given the output provided by the TAXSIM program. An obvious one is to compute the average marginal tax rate within each year t and state j. This is calculated as the mean of the household marginal tax rates obtained from the TAXSIM program. As table 4 shows, the average federal bracket is 20.2 percent, and the average marginal tax rate (which accounts for various allowances) is 19.2 percent. The state rates shown in the table vary from zero in Texas and Florida, which charge no income tax, to an average marginal tax rate of 7.4 percent in New York.

This measure, however, accounts neither for transfers nor for heterogeneity amongst household tax rates. For instance, a mean marginal tax rate of 20 per cent in a state could be due to all households paying a marginal tax rate of 20 per cent; to the bottom fifth of the population paying 100 percent and the rest nothing; or to the top 20 per cent paying 100 percent and the rest nothing. These three cases have substantially different implications for redistribution. Hence we also construct a more direct measure of how much the tax system compresses or redistributes income. This “income compression” measure is defined as:

$$1 - \frac{sd_{jt}\left(\text{income}_{ijt} - \text{tax liability}_{ijt} + \text{transfers}_{ijt}\right)}{sd_{jt}(\text{income}_{ijt})} \tag{2}$$

where the tax liability is obtained from the TAXSIM program, and i denotes the household. The above measure is computed for households that reside in a given state j in a given year t as one minus the ratio of the standard deviation of income after tax and transfers to the variance of income before tax and transfers. If all households faced the same marginal tax rate, and there were no allowances, then this measure would exactly equal the marginal (and average) tax rate, and it would not matter which measure was used. Given that the mean marginal tax rate conceal large differences in the households' marginal tax rates, the income compression measure will be our preferred measure of redistribution through the tax system.

Table 4 displays the two tax measures for the whole of the US and for six of the largest US states. The first column shows that the average marginal federal tax rate is 19.2 percent and that the average marginal state tax goes from 2.2 in Pennsylvania to 6.3 in New York. The last column of Table 4 reports the income compression measure, which averages 28.3 percent over the whole US, but differs from 22.8 percent in Florida (where there is no income tax), to 33.0 percent in New York, traditionally viewed as one of the more progressive states. This means that the tax and transfer system is 50 percent more redistributive in New York than in Florida. Taken together, these numbers show that there is enough variation across states to get meaningful results, a key issue if we are to convincingly assess the model predictions. Results will be reported for both measures (the correlation is 0.81 between the two measures).

4 The Empirical Evidence

The substantial variation of tax regimes across US states and over time we discussed in the previous section allows us to show how the mean and standard deviation are related to redistribution of consumption through the tax system. The regressions use year-state level grouped data where the measures of tax redistribution vary over time and across states. Cells are defined for each state for every two years: the minimum cell size was 50 households. Putting two years together allows more states to be included in the regressions given the minimum cell size of 50. In choosing the cell size we face a trade-off: choosing a higher number of households in each cell implies fewer observations in the regression leading to higher standard errors whereas a smaller cell size generates a larger number of observations in the regression but increases the within cell measurement error. Setting the cell size to 50 may seem low, but for many states there are few observations: this choice leaves 34 states to be included in the regressions with a total number of 227 observations.[15]

Throughout we refer to the mean and standard deviation of consumption as the mean and standard deviation of log consumption in each cell. The ratio of the standard deviation to the mean of consumption is defined as the relative dispersion or coefficient of variation of consumption. All these variables were regressed on the two different measures of tax redistributiveness. To control for observed heterogeneity at the household level, the following procedure was adopted: in the first stage household consumption was regressed against a

[15]Using different cell sizes, or combining one, or three years together, does not qualitatively change the results. We also experimented with trimming out the households with the highest and lowest level of consumption, which again does not quantitatively change the results. We omit reporting these other results in the tables for brevity.

cubic polynomial in age, education, family-size, month, year, race, and marital status. Group averages were then constructed from the residuals.[16]

4.1 Mean Consumption

Table 5 shows the results using mean consumption as the dependent variable. The first column includes a full set of state dummies in the regression. However, while the effect is as predicted by the theory, the estimated results are marginally not significant at the 10 percent level in both panel A (which reports results for our preferred measure of redistribution through the tax system) and in panel B which reports results for the mean marginal tax rate. The size of the effect shows that if the marginal income tax rate (or rather, the equivalent redistributive measure) were reduced by 10 percent then there is a 1.8 fall in mean consumption in panel A and a 1.5 percent decrease in panel B. A 10 percent difference is roughly the difference between Texas and New York. This difference seems small.

Column (2) includes a set of year dummies in the regression, and it shows that mean consumption decreases as the degree of taxes redistributivness increases, and the result is significant at the 5 percent level for our preferred measure. Moreover, the estimated coefficient is much larger. In columns (3) and (4) we have first differenced the data, which will remove any fixed differences across states. Column (4), which includes state fixed effects in the differenced regression, allows for the growth rate of mean consumption to be different across states. The results in columns (3) and (4) are very similar. The coefficients are again negative, and significant (at the 1 percent level) in panel A. These results suggest that a 10

[16] Omitting these first stage controls did not substantially change the results.

percent more redistributive tax system is reducing mean consumption by around 10 percent. While the estimated effect is smaller and not significant in panel B (it is around 1.5 percent), we believe this is due to the weakness of this tax measure in measuring redistribution.

4.2 Controlling for Potential Endogeneity:

Columns (1)-(4) in Table 5 report the current tax system regressed against the current level of consumption. However, in part they may be co-determined. For example, a high income shock to the state would result in estimated mean consumption to be higher, and is likely to change the measure of tax redistribution. This is likely to bias the results. It would be useful to look at a measure of the expected tax system where the expectation depends on the effectiveness of the state administration in raising tax revenue, and the likely taste for redistribution of the local residents in the state. We accomplish this by instrumenting the tax system with a set of lagged political variables, and two measures of tax efficiency.

Political variables are candidate instruments since they are likely to reflect attitudes towards redistribution, rather than general economic conditions. The political instruments used are the relative percent of votes for the republican candidate in presidential elections; whether the state governor was a democrat or republican, and who controlled the state legislature.[17] The instruments also include a measure of the tax raising ability, or 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

[17]The data were made available by Tim Storey at the National Conference of State Legislatures.

it was necessary to linearly interpolate the two series for some years. A full discussion of these variables is contained in these two references.

Columns (5)-(7) in Table 5 investigate the effect of using the instruments. For both tax measures, the rank test is significant in columns (5) and (6), which use state dummies, and use state and year dummies, but fails in column (7) where the data is differenced. Moreover, the Sargan test does not reject the over-identifying restrictions for the income compression measure (panel A), and only rejects the mean marginal tax rate measure (panel B) when the data are differenced (at least at the 10 percent level). Combining the rank and Sargan tests suggests that the political variables are suitable instruments for a regression of the tax measure on mean consumption, at least in levels. The results for levels show that the effect is not only negative for both measures of the tax system, but also significant at the 1 percent level when state dummies only are included, and at the 5 percent level when year dummies are added. When the data are differenced, the results in panel A (using the income compression measure) remain significant at the 10 percent level. Overall, the results strongly support the hypothesis that a more redistributive tax system does result in lower average consumption. The result in column (5) suggests a 10 percent reduction in income tax (using the redistribution measure) reduces mean consumption by 8.5 percent.

4.3 Standard Deviation of Consumption

Results for the standard deviation of log-consumption are reported in Table 6. In the first two columns in panel A, which used our preferred measure of how redistributive the tax system is, the estimated coefficient in the regression is not significant, and in column (2), which includes both state and year dummies in the regression, is even positive. The estimated effect in column (1) suggests that a 10 percent reduction in income tax rates (using the redistributive measure) reduces inequality by one percent. Using the mean marginal tax rate, the estimated coefficient is not significant when only state dummies are used, but is significant at the 10 percent level if year dummies are also included. Columns (3) and (4) first difference the data to remove any fixed state effect in the amount of inequality in each state. For our preferred measure of the tax system, the estimated coefficient is larger, and is significant at the 5 percent level. Similarly, the results are also negative and significant at the 5 percent level in panel B, which used the mean marginal tax rate. Both tax measures suggest that, as we would expect, redistribution through the tax system reduces cross-sectional inequality within the state.

The final three columns show the effect of instrumenting. The rank test suggests that the the instruments are not appropriate in column (7). The Sargan test of the over-identifying instruments is not rejected in Panel A in columns (5) and (6), but is rejected at the 10 percent level in Panel B. This suggests that we have good instruments for the income compression measure, but not for the mean marginal tax rate for this regression. Nevertheless, the IV-regression results show that all six estimated coefficients are negative. Moreover, when state effects only are included in column (5), the results are significant at the 5 percent level for both tax measures. The results in panel A suggests that half the difference in inequality between states can be explained by differences in how redistributive the tax system is. The results remain significant at the 10 percent level for the income compression measure when year effects are also included, or when the data are differenced (although again there is a large increase in the estimated coefficient). Overall the results suggest that making the tax system more redistributive substantially reduces the standard deviation of consumption, or cross-sectional variability, as we would expect.

4.4 Coefficient of Variation

Tables 5 and 6 show that both the mean and the variance of consumption are reduced when the tax system is more redistributive, at least for our preferred measure, and in our preferred results. The ratio of these variables is investigated in table 7. The results are broadly in line with those reported in table 6. In the first two columns the estimated effect is never significant in panel A, using our preferred measure of the tax system, but is significant at the 10 percent level in the second column when the regression uses the mean marginal tax rate. In columns (3) and (4), in which the data is first differenced, the estimated coefficient is larger in absolute sign, and is now significant (at the 10 percent level in the third column, and at the 5 percent level in the fourth column). However, it is not significant when we use the mean marginal tax system in the regression.

When the tax system is instrumented in columns (5)-(7), the results of the Sargan test are the same as in Table 6: the Sargan test rejects the over-identifying restrictions in columns (5) and (6) for Panel B. Combining these results with the rank test suggests that only Panel A, columns (5) and (6), can safely be interpreted. Nevertheless, all the IV-regressions estimate a negative effect on the coefficient of variation. In column (5), when state effects only are included in the regression, the results are significant at the 5 percent level in the top panel, and at the 10 percent level in Panel B. The results are no longer significant when year effects are included, column (6), while when the data are also differenced, the coefficients are only significant at the 10 percent level in Panel A. In column (6), where year dummies are included, the estimated coefficient is larger, but so is the standard deviation of the estimated coefficient, which means that it is not significant. Nevertheless, we are encouraged by the result in column (5) which shows that when taxes are reduced by 10 percent (roughly the difference between Texas and New York) the tradeoff is between a 10 percent reduction in mean consumption and a 50 percent reduction in inequality.

In our view these results are remarkable. Overall, the results show that the coefficient of variation falls as the tax system becomes more redistributive, and for our preferred measure this difference is always negative, and is significant if either the data is differenced, or if the tax system is instrumented as in column (5). Moreover, we know that the mean marginal tax rate is not a good measure of how much redistribution there is through the tax system, and this is confirmed by the results, which for the most part are not significant (although they do have the same sign, in most cases as our preferred measure of the tax system). As we saw in the theory section, in the presence of idiosyncratic risk, there is both an insurance and a distortionary effect of redistributive taxes. In the model, the insurance effect was sufficiently strong for the coefficient of variation to fall with taxes, and this insight is confirmed by the results in Table 7.

5 Conclusions

This paper first shows that existing macro models of idiosyncratic risk imply a strong insurance effect of redistributive tax and transfer policies, as well as the standard distortionary effect. The first effect is captured by a negative relationship between taxes and the standard deviation of consumption for any cross-section of households in the economy. The second effect is shown by a negative relationship between taxes and mean consumption. We show that such models typically imply a drop in the coefficient of variation of consumption as taxes become more redistributive, indicating a rather strong insurance effect of taxes.

We then use US-state data in order to test for these effects of taxation on the consumption distribution. We exploit the high variation of taxes across states and over time; using state data is a natural test and avoids some of the difficulties in exploiting differences across countries. Nevertheless, the empirical analysis controls for some of the differences between US states that might otherwise contaminate the results: we include state and time dummies in the regression; we difference the data to remove any state fixed effects; and we instrument the tax system using political and other variables. We find that both the distortionary and the insurance effect on consumption are present, as there is a negative correlation between taxes and the mean and standard deviation of consumption. Our preferred estimate (using the income compression measure) shows that a 10 percent reduction in the tax rate reduces mean consumption by 10 percent, but can explain half the difference in within state consumption inequality across US states in our sample.[18]

Interestingly, we also find a negative correlation between taxes and the coefficient of variation of consumption across states. Together with the result on the standard deviation of consumption, this indicates the presence of a robust insurance effect of marginal taxation in the data. If redistributive policies are not compressing an income process that includes

[18]Since we sample households aged between 25 and 55, we have already removed the differences in inequality between states caused by demographic differences.

idiosyncratic risk, then it is difficult to explain why we observe a negative effect of redistributiveness on the standard deviation of consumption when we do not control for the standard deviation of pre-tax income. Our study thus suggests that the insurance effect must be present.

Our main conclusion is that the insurance effect of taxes is a non-trivial consideration for policy analysis and that researchers should address it together with the distortionary effects in carefully calibrated macro models of idiosyncratic risk. That is, insuring idiosyncratic risk is indeed a key concern in the construction of optimal policies. Papers such as those of Aiyagari and McGrattan (1998), Floden (2001), Domeij and Heathcote (2002), and Conesa, Kitao and Krueger (2006), thus stress an important issue in the evaluation of policies financed through marginal income taxes.

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Table 1: Income thresholds for current 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 refers to 1998 and is available from 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.

Table 2: State Individual Income Tax Rates in the US

State	Tax Rates		Exemptions		
	low	high	single	married	dependents
Alabama	2.0	5.0	1,500	3,000	300
Alaska	no state tax				
Arizona	2.87	5.04	2,100	4,200	2,300
California	1.0	9.3	72*	142*	227*
Colorado	4.63	4.63		none	
Florida	no state tax				
Georgia	1.0	6.0	2,700	5,400	2,700
Illinois	3.0	3.0	2,000	4,000	2,000
Indiana	3.4	3.4	1,000	2,000	1,000
Kentucky	2.0	6.0	20*	40*	20*
Louisiana	2.0	6.0	4,500	9,000	1,000
Maryland	2.0	4.75	1,850	3,700	1,850
Massachusetts	5.6	5.6	4,400	8,800	1,000
Michigan	4.2	4.2	2,800	5,600	2,800
Minnesota	5.35	7.85	2,900	5,800	2,900
Mississippi	3.0	5.0	6,000	12,000	1,000
Missouri	1.5	6.0	2,100	4,200	2,100
Nevada	no state tax				
New Jersey	1.4	6.37	1,000	2,000	1,500
New York	4.0	6.85	-	-	1,000
North Carolina	6.0	7.75	2,500	5,000	2,500
Ohio	0.691	6.98	1,050	2,100	1,050
Oklahoma	0.5	6.75	1,000	2,000	1,000
Pennsylvania	2.8	2.8		none	
South Carolina	2.5	7.0	2,900	5,800	2,900
Tennessee	taxes unearned income only				
Texas	no state tax				
Virginia	2.0	5.75	800	1,600	800
Washington	no state tax				
Wisconsin	4.6	6.75	700	1,400	400

*Refers to Tax Credits rather exempt income. The data refers to 1998 and is available from the Federation of Tax Administrators at 444 N. Capital Street, Washington DC. The 'min.' and 'max.' refers to the minimum and maximum tax bracket in the state, 'single' and 'married' refer to single filers and households in which the husband and wife jointly file, while 'dependents' refer to each additional dependent person for which the file may claim.

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

	average	average if received	% receive
wages	32,950	34,281	96.1
social security	272	6,944	3.9
supplementary security income	73	4,339	1.6
unemployment/workers compensation	378	2,766	13.6
public assistance / welfare	166	4,216	3.9
food stamps	104	1,521	6.8
total transfer	994	4,389	22.6

Data is constructed from reported responses in the March supplement of the CPS for the years 1982-1998. 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: Measuring tax redistributiveness by state:

	marginal rate	tax bracket	income compression
Federal	19.2	20.2	
State:			
Overall	3.7	4.2	27.7
California	5.0	5.3	30.3
Florida	0	0	22.5
New York	6.3	7.4	32.6
Ohio	3.8	4.0	28.4
Pennsylvania	2.2	2.4	26.8
Texas	0	0	22.8

Data is constructed using income from the March supplement of the CPS for 1982-1998, 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).

Table 5: The effect of taxes on mean log-consumption.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A:							
tax rate	-0.177	-0.706	-1.071	-1.145	-0.857	-3.547	-3.951
	(0.110)	(0.318)	(0.354)	(0.395)	(0.284)	(1.522)	(2.226)
p-value	0.111	0.028	0.003	0.004	0.003	0.021	0.078
constant	7.195	7.385	0.020	-0.171	7.659	8.530	-0.127
	(0.066)	(0.123)	(0.014)	(0.023)	(0.090)	(0.460)	(0.100)
Sargan test					4.471	4.764	4.457
p-value					(0.484)	(0.445)	(0.486)
Rank test					8.36	11.24	1.12
p-value					(0.000)	(0.000)	(0.353)
Panel B:							
tax rate	-0.146	-0.305	-0.186	-0.148	-0.610	-1.896	-0.807
	(0.090)	(0.329)	(0.300)	(0.436)	(0.200)	(0.800)	(3.713)
p-value	0.105	0.355	0.641	0.735	0.003	0.019	0.828
constant	7.173	7.228	0.012	-0.190	7.590	8.026	-0.194
	(0.062)	(0.106)	(0.014)	(0.022)	(0.075)	(0.243)	(0.088)
Sargan test					5.068	7.311	9.999
p-value					(0.408)	(0.198)	(0.075)
Rank test					2.42	8.51	1.18
p-value					(0.038)	(0.000)	(0.323)
Dummies:							
state	yes	yes		yes	yes	yes	yes
year		yes	yes	yes		yes	yes
diff.			yes	yes			yes
instr.					yes	yes	yes

Panel A refers to regressions involving the ratio of the standard deviation of after tax income to the standard deviation of before tax income, while Panel B refers to using the mean marginal tax rate. Here *state* refers to the inclusion of state dummies, *year* refers to the inclusion of year dummies, *diff.* refers to whether the data was first-differenced, while *instr.* refers to instrumenting the tax system. All regressions control for household characteristics. The cell size was 50. Huber standard errors are reported in parenthesis.

Table 6: The effect of taxes on the standard deviation of log-consumption.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A:							
tax rate	-0.055	0.043	-0.756	-0.851	-0.461	-1.890	-3.267
	(0.084)	(0.237)	(0.362)	(0.370)	(0.209)	(1.106)	(1.786)
p-value	0.509	0.855	0.038	0.023	0.028	0.089	0.069
constant	0.514	0.477	0.038	0.040	0.596	1.052	0.078
	(0.050)	(0.092)	(0.011)	(0.017)	(0.066)	(0.334)	(0.080)
Sargan test					8.961	4.499	5.310
p-value					(0.111)	(0.480)	(0.379)
Rank test					8.36	11.24	1.12
p-value					(0.000)	(0.000)	(0.353)
Panel B:							
tax rate	-0.106	-0.467	-0.032	-0.181	-0.307	-0.555	-2.834
	(0.068)	(0.240)	(0.376)	(0.391)	(0.145)	(0.551)	(3.250)
p-value	0.119	0.053	0.931	0.643	0.036	0.315	0.384
constant	0.517	0.613	0.032	0.026	0.555	0.651	0.010
	(0.046)	(0.077)	(0.011)	(0.017)	(0.054)	(0.167)	(0.077)
Sargan test					10.656	9.945	8.620
p-value					(0.059)	(0.077)	(0.125)
Rank test					2.42	8.51	1.18
p-value					(0.038)	(0.000)	(0.323)
Dummies:							
state	yes	yes		yes	yes	yes	yes
year		yes	yes	yes		yes	yes
diff.			yes	yes			yes
instr.					yes	yes	yes

Panel A refers to regressions involving the ratio of the standard deviation of after tax income to the standard deviation of before tax income, while Panel B refers to using the mean marginal tax rate. Here *state* refers to the inclusion of state dummies, *year* refers to the inclusion of year dummies, *diff.* refers to whether the data was first-differenced, while *instr.* refers to instrumenting the tax system. All regressions control for household characteristics. The cell size was 50. Huber standard errors are reported in parenthesis.

Table 7: The effect of taxes on the coefficient of variation of log-consumption.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A:	*tax rate*	-0.045	0.090	-0.689	-0.779	-0.412	-1.683	-3.001
		(0.083)	(0.236)	(0.357)	(0.364)	(0.206)	(1.080)	(1.727)
	p-value	0.586	0.704	0.055	0.034	0.047	0.121	0.084
constant		0.518	0.468	0.037	0.049	0.571	0.976	0.085
		(0.050)	(0.091)	(0.011)	(0.017)	(0.065)	(0.326)	(0.078)
	Sargan test					9.245	4.992	5.749
	p-value					(0.100)	(0.417)	(0.331)
	Rank test					8.36	11.24	1.12
	p-value					(0.000)	(0.000)	(0.353)
Panel B:								
	tax rate	-0.099	-0.452	-0.015	-0.168	-0.272	-0.446	-2.761
		(0.067)	(0.239)	(0.374)	(0.387)	(0.143)	(0.550)	(3.181)
	p-value	0.145	0.061	0.966	0.664	0.060	0.418	0.387
	constant	0.523	0.616	0.032	0.036	0.534	0.604	0.021
		(0.046)	(0.077)	(0.011)	(0.016)	(0.053)	(0.167)	(0.075)
	Sargan test					10.763	9.769	8.435
	p-value					(0.056)	(0.082)	(0.134)
	Rank test					2.42	8.51	1.18
	p-value					(0.038)	(0.000)	(0.323)
Dummies:								
	state	yes	yes		yes	yes	yes	yes
	year		yes	yes	yes		yes	yes
	diff.			yes	yes			yes
	instr.					yes	yes	yes

Panel A refers to regressions involving the ratio of the standard deviation of after tax income to the standard deviation of before tax income, while Panel B refers to using the mean marginal tax rate. Here *state* refers to the inclusion of state dummies, *year* refers to the inclusion of year dummies, *diff.* refers to whether the data was first-differenced, while *instr.* refers to instrumenting the tax system. All regressions control for household characteristics. The cell size was 50. Huber standard errors are reported in parenthesis.

Single discount factor economy (rho=3)

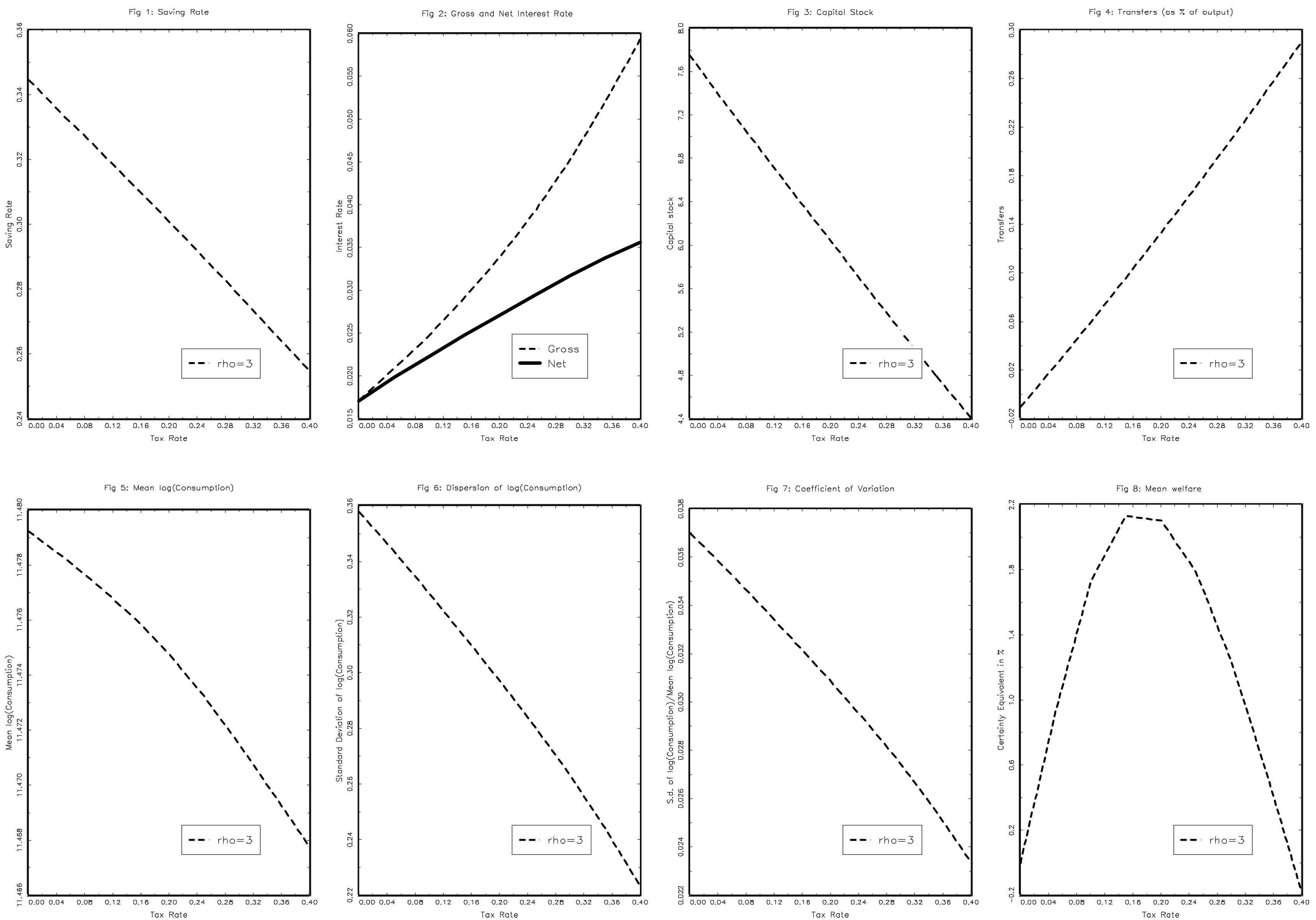

Fig 9: Unconditional Cash on Hand Distributions varying taxes (rho=3)