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Redistributive Policies through Taxation: Theory and Evidence

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Abstract

Increasing marginal tax rates and making payments to the poor reduce inequality and introduce savings dis-incentives. Using a heterogeneous agent model with incomplete markets, we show that higher taxes (and transfers) decrease consumption inequality but also mean savings and mean consumption. This demonstrates the trade-off between equity and efficiency. These theoretical predictions are tested by exploiting differences in tax rates across US states. Using two surveys, the Consumer Expenditure Survey and the Current Population Survey, we show that the empirical evidence supports the theory, and that there is a comparatively small fall in efficiency for a given gain in equity associated with higher taxation

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1 Introduction

Two distinct effects commonly arise in models in which income is taxed, and tax revenues redistributed. First, taxes and transfers reduce undiversifiable idiosyncratic earnings risk by transferring money from agents whose labor income is currently high to agents whose labor income is low. If agents are *ex ante* identical, then this has a substantial risk sharing effect: it reduces the cross sectional variance of after tax income and of consumption, and generates a more equitable allocation of resources in the economy. Second, taxes can also cause savings distortions that may reduce average production and consumption through lower investment and hence a lower accumulation of physical capital. Policy makers are typically faced with a trade-off between equity and efficiency. This paper constructs a simple heterogeneous agent model to discuss the trade-off between inequality (equity) and distortions (efficiency) and then tests the model by exploiting the variability in tax rates across the different US states.

To assess the equity-efficiency trade-off, a heterogeneous agent framework is necessary. The earliest such models, by Huggett (1993) and Aiyagari (1994), analyzed the general equilibrium implications of undiversifiable, idiosyncratic, labor income risk in the presence of liquidity constraints. A parallel literature focusing on precautionary saving and individual behavior featured the same microeconomic assumptions and has received substantial attention and empirical support at both the microeconomic[1] and macroeconomic level[2]. As a result of this positive evidence, the general equilibrium counterparts of these models are now routinely being used to investigate the implications of alternative policy regimes for macroeconomic outcomes (see Rios-Rull (1999) for a survey of applications and computational approaches). This paper follows this approach, augmenting the Aiyagari (1994) infinite horizons model by including taxes, transfers and discount factor heterogeneity. This last feature better matches the wealth distribution observed in the data (see Krusell and Smith (1998) and Carroll (2000)). Two studies have made a similar simulation exercise to

[1] Deaton (1991), Carroll (1992, 1997), Carroll and Samwick (1998), Hubbard, Skinner, Zeldes (1995), Attanasio, Banks, Meghir and Weber (1999), Cagetti (1999) 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] See, for instance, Ludvigson and Michaelides (2001).

assess efficiency and welfare. Floden (2001) analyzes the effect of various combinations of transfer and debt policies, while Domeij and Heathcote (2002) analyze the effect of changes in marginal taxation. While using a similar theoretical framework, this paper assesses the empirical implications of the model since empirical work to date has mostly focused on testing the implications of partial equilibrium models either through the explicit estimation of structural parameters (for instance, Gourinchas and Parker, 2002) or through the illustration that key correlations implied by the model hold up in the data (for instance, Carroll and Samwick, 1998). The general equilibrium version of the model, or the more general idea of an equity-efficiency tradeoff from higher taxation, has not yet come under an empirical scrutiny of similar magnitude.

By exploiting variations in tax policy across US states we can compare the predictions of the model with observed outcomes. The policy trade-off is investigated by looking at the mean of saving and at the mean, the standard deviation, and the coefficient of variation of consumption in each state using household survey data. For mean saving and mean consumption, the use of aggregate data is inappropriate since they do not directly aggregate, see Attanasio and Weber (1993, 1995), while the construction of higher moments requires microeconomic data. We use the Consumer Expenditure Survey (CEX), a large survey of US households available on a continuous basis for 1980-1998 to construct consumption measures. US data are ideal for the empirical investigation as we can exploit the substantial variation in taxes across the different states. Variation across countries could also be exploited, but such variation may instead reflect differences in institutional, cultural and other country-specific features. Moreover, using the same survey across tax regimes reduces the chance that differences in the survey design generate the different measured policy responses.

Among the constructed variables, the coefficient of variation of consumption parsimoniously summarises the main implications of the model. The reduction of the numerator (the standard deviation of consumption) is the policy benefit and the reduction in the denominator (the mean of consumption) is the cost. The empirical test of the effect of different redistributive regimes across American states looks at how the coefficient of variation of consumption varies across regimes. By combining the simulation exercise with the empirical evidence we can establish how successful theoretical general equilibrium models of this type are in assessing this trade-off. It is important to emphasize that despite the voluminous general equilibrium, incomplete markets, heterogeneous agent literature, very little work exists that confronts the implications of these models with the data (the empirical work that exists on precautionary savings models usually tests partial equilibrium implications).

The empirical results in this paper show that higher taxes are negatively correlated with both mean consumption and the saving rate. Also, consumption inequality is lower in states with more redistributive tax policies, which can potentially arise from both pure redistribution from rich to poor, and from insurance against unexpected changes in income. Finally, we show that the coefficient of variation declines with increases in taxation, suggesting that there is a small fall in efficiency for a large gain in equity. We interpret these findings as being broadly consistent with the main theoretical predictions of the model.

The structure of the paper is as follows. Section 2 describes the theoretical model and section 3 analyzes the implications for the observable variables. Section 4 describes the data sets and proposes two measures of tax redistributiveness in the different US states. Section 5 discusses the empirical findings and section 6 concludes.

2 The Model

The model is a variant of Aiyagari (1994), extended to include an exogenous redistributive policy, and discount factor heterogeneity to generate more plausible wealth distribution profiles. The focus is on the effects of different redistributive policies on the various measures of the trade-off between risk sharing and productive efficiency.

2.1 Production and factor prices

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 all the usual neoclassical properties: diminishing marginal returns with respect 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 $r = R - \delta$.

2.2 The government budget

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.[3] The government's balanced budget constraint in each period therefore becomes:

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

2.3 The household problem

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 (exogenously given) borrowing constraint. The household pays taxes at a flat marginal tax rate, τ, on both capital and labor income, but receives a common per-capita lump-sum transfer T that is financed from taxation. Policies are exogenous and constant over time and there is no commitment problem on the part of the government in enforcing its policy.

[3]Note that we fix the marginal tax rate on capital and labor to be identical. As will be seen in the empirical section, tax jurisdictions rarely distinguish between these different sources of income when assessing the household's tax liability.

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, generating a price vector $\{r, w\}$.

The consumer's problem is:

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

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

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

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

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.[4]

The computations will allow no borrowing ($b = 0$).[5] 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:

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

2.4 Preferences

We use the standard CRRA utility function, without leisure:

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

[4] We abstract from government spending on public goods, and any possible inefficiency in raising revenue and/or spending by governments. We are interested solely in the redistributive aspect of taxes and transfers. In a recent paper, Fatás and Mihov (2001) look at the effects of government spending on consumption and employment.

[5] Allowing the borrowing limit to vary exogenously is trivial and does not affect the qualitative comparative statics of varying the tax rate.

with $\rho > 0$. This assumes that the labor choice decision is exogenous, even though there are taxes on marginal earnings. The motivation for this assumption is empirical: prime-age males are typically estimated to have extremely low labor supply elasticities, see for instance Card (1994) and Hyslop (2001). It is true that the labor supply elasticity of the female spouse is typically estimated to be much higher (Hyslop (2001)) but building explicit micro-foundations for this fact requires modeling the marriage decision and the combined labor supply choice facing a household. This would substantially complicate the analysis, and is beyond the scope of this paper. The chosen formulation implicitly assumes that most of the distortions arising through taxation result from the inefficient allocation of capital rather than labor.

2.5 Labor income

Labor income risk is non-diversifiable (perhaps because of moral hazard and adverse selection) 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 (it will be set to 0.92). This might not be an uncontroversial assumption. A large literature in applied labor economics on earnings dynamics either assumes that there exists a unit root in individual earnings (Abowd and Card (1989) and MacCurdy (1982), for instance) or cannot reject the hypothesis of a unit root (Meghir and Pistaferri (2001), for example). The literature on buffer stock saving, following Deaton (1991) and Carroll (1992), usually assumes that labor income can be decomposed into a permanent and a transitory component (see Carroll and Samwick (1998) for evidence about this). In these papers, the demeaned growth in individual labor income follows:

$$\Delta \ln Y_{it} = \ln N_{it} + \ln U_{it} - \ln U_{it-1}, \tag{2}$$

Individual earnings growth in (2) has a single Wold representation that is equivalent to the MA(1) process for individual earnings growth estimated using household level data

(MaCurdy (1982), Abowd and Card (1989), and Pischke (1995)).[6]

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 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 therefore want the model to be as close as possible to this standard specification. However, this might be an important assumption given the non-monotonicity in results between a persistent AR(1) process and a unit root process, as pointed out by Deaton (1991) in partial equilibrium and Krusell-Smith (1997) in general equilibrium.

2.6 Equilibrium

We assume that there are no problems of commitment on the part of the government to pre-announced tax rates. Once a tax rate is announced, economic agents solve their individual consumption problem given the tax rate and prices. Prices are then 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.

3 Implications of Varying Tax Rates

3.1 Parameter Choice and Solution Method

Each time period is a year. We use a CRRA coefficient equal to 3 and $\alpha = 0.36$, so that the labor share is about $\frac{2}{3}$ in production. 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. We use a seven point approximation and a quadrature

[6] Although these studies generally suggest an MA(2) process, an MA(1) is also found to be a good approximation.

method to take expectations (see Burnside (1999) for a clear exposition of the practical issues involved). We rely on 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 simulations). Cubic spline interpolations are used to interpolate between grid points.

3.2 Constant discount rate economy

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 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[7]. On the other hand, the dispersion (standard deviation, σ) of log consumption in the economy falls (figure 6); this is the redistributive value from 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; the reduction in inequality outweighs the distortionary effect for all tax rates in this economy according to this metric.

We will be interested in making welfare evaluations from varying the tax rates. To do so, we compute aggregate mean social welfare as the average of the value functions using the time-invariant distribution of cash on hand. This utilitarian social welfare function (denote it by U) increases if consumption rises, if inequality is reduced (since the welfare function is concave) or if uncertainty is reduced (since agents are risk averse). To compare two different economies, we find the percent of life-time consumption that agents in one system are prepared to give up to accept the policy change. We report all our results with the zero tax rate case as the benchmark (call this economy A). It can be shown that the proportional, percentage life-time consumption agents are prepared to give up to move from one regime

[7]We have scaled consumption up to be near the mean log consumption values in the data.

(A) to another (B) is given by

$$100 * [(\frac{U_B}{U_A})^{1/(1-\rho)} - 1]$$

This is the metric we use in our evaluations. Figure 8 illustrates the trade-off between equity and reditribution. For low tax rates the benefit outweighs the cost as the reduction in the variance of possible consumption outcomes (figure 6) dominates the reduction in mean consumption (figure 5). Nevertheless, as tax rates rise the reduction in mean consumption eventually implies a lower welfare for higher taxes (figure 8). The optimal tax rate for this calibration is 16 percent and agents would be willing to give up around 2.1 percent of mean consumption to move from the zero-tax rate economy to the 16% one, illustrating the substantial benefit from lowering inequality once the utilitarian comparison is used. 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 squeezed to be in a narrower range with higher taxes and transfers.

The results are robust to varying the structural parameters of the model. As a general rule, varying structural parameters that increase the value of risk-sharing increases the value of redistributive taxation. Specifically, a more persistent earnings process or a higher risk aversion coefficient leads to more value for risk sharing. Higher risk sharing on the other hand takes place at the cost of substantial productive (and mean consumption) distortions.

3.3 Generating an Empirically Plausible Wealth Distribution

Krusell and Smith (1998) show that the observed wealth distribution in the data can be matched once discount factors are allowed to change stochastically in the economy with a small variation from their unconditional average. Carroll (2000) matches some key features of the observed wealth distribution using the same idea but a simpler heterogeneity in discount rates by assuming that two thirds of the population is "impatient" and one third "patient". We follow Carroll (2000) and assume that the impatient households have a discount factor equal to 5.5% and the patient ones have one equal to 4% so that the unconditional average of discounting in the economy remains equal to 5%. The patient households will, in equilibrium, end up holding a larger level of wealth. We also assume that taxes are paid by everybody but transfers are only received by the poorest segment of the population (the impatient consumers). This is intended to capture in the simplest possible way the progressivity of the tax system so that richer people are taxed disproportionately relative to the poorer agents in the economy.

The results are presented in figures 10-19. Figures 10-11 show what happens to the wealth distribution when the tax rate is varied from zero to forty percent. Figures 10 and 11 compare the unconditional wealth distribution for the impatient (figure 10) and the patient consumers (figure 11). A higher tax rate leads to higher transfers being passed to the impatient consumers, and therefore their wealth distribution shrinks as the tax rate is raised. Perhaps surprisingly, the opposite results are predicted for the patient consumers in figure 11. Even though these agents do not receive transfers, their wealth distribution would still be expected to be compressed when taxes are higher. Nevertheless, we will see shortly that both the gross (and net) interest rate increase as taxes are raised. Given that these agents save a bigger proportion of their incomes, this general equilibrium effect tends to make their distributions more unequal as taxes are raised.[8]

The effects from varying the tax rate on key variables of the model that will be later compared to the data are presented in figures 12-19. The general direction of how tax rates affect the key variables of interest at the aggregate level (the weighted average of the patient and impatient consumers) is similar to the constant discount rate economy. Higher tax rates are associated with lower saving rates (figure 12), with higher gross and net interest rates (figure 13), with a lower capital stock (figure 14), and higher transfers (figure 15). Figures 16 and 17 separately present the results for the patient and impatient households, and the average across household types. The dotted line in the figures is the average and is therefore always between the two solid lines that represent the patient and impatient consumers. Mean (log) consumption is again decreasing in the tax rate (figure 16), as is the standard deviation of (log) consumption (figure 17). Nevertheless, the rate of change in response to the tax rate

[8]It is also useful to point out that the wealth distribution for the patient consumers is more skewed to the right (relative to the distributions for the impatient consumers), and the proportion of total wealth held by these consumers is higher (compare figures 10 and 11 which both have the same domain).

is very different between the two subgroups in the population. Mean consumption falls much faster for the patient households since they bear the cost of taxation without receiving the benefit of the transfer. The standard deviation of consumption falls faster for the impatient households (figure 17) as they receive the benefit of the transfer. This is most clearly reflected in the coefficient of variation (figure 18). It falls for the impatient households but is mostly rising for the patient households. In figure 19, mean welfare (computed as described in the last section) for impatient households has a hump shape as a function of the tax rate but this is not true for the patient households that prefer a zero tax rate. Note that a political equilibrium can sustain a positive tax rate since the impatient households that make up two thirds of the population prefer a positive tax rate due to the value associated with redistribution through the tax system.

3.4 Empirical Implications

The calibration exercise implies that the mean and the standard deviation of consumption are both falling as taxes are raised. The coefficient of variation is also generally decreasing with increases in taxes. This gives a set of implications for consumption, which can be confronted with the data. Moreover, the mechanism through which taxes act on consumption is through saving and capital accumulation: the saving rate falls as marginal tax rates increase, as does the capital stock. These effects are consistent across the two calibration exercises, which differ in the assumptions about the discount rate. We next compare the testable implications of the model with the data.

4 Data Description

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 various components of consumption, together with a variety of household characteristics. It also includes the state of residence. The survey is designed as a rotating panel, with households being interviewed 5 times at quarterly intervals (although the first is a contact interview from which no information is made available). Each quarter, households reaching their fifth interview drop out and are replaced by a new household. Since the survey records detailed information on several expenditure items, 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, clothing and books, each deflated by the appropriate price index. Saving (deflated by the Stone price index for non-durable consumption) is the sum of the amount held in saving accounts at banks, credit unions, savings and loans institutions, checking accounts, brokerage institutions, in US saving bonds, and the estimated value of stocks, bonds, and other liquid securities. We restrict the sample to those households for which full state information is available,[9] 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.

4.1 Measuring taxes

Constructing a measure of the tax burden in each state is not a trivial task and a number of problems must be addressed in the process. For instance, US households are subject to taxes levied at the federal and state levels, by county administrations, and by schoolboards;

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

these taxes include income taxes, sales taxes, property taxes and duty. We concentrate on income tax, which is raised at both the federal and state level: this is driven by our identification strategy that exploits variation across, but not within, states. Specifically, we could construct a measure of property taxes but this measure would be problematic because property taxes are largely levied at the county/schoolboard/city level. Equivalently, there is a substantial variation within states between lower jurisdictions. We avoid using sales taxes for the same reason. Moreover, sales taxes are paid at the place of sale and not that of residence, which makes it extremely difficult to devise a measure of sales taxes levied on the households within the state if cross-border shopping takes place. In the CEX, the spending figure excludes sales taxes, which makes spending comparable across states.

Table 1 illustrates the complexity of the federal income tax system: the 1998 federal marginal tax rate varies non-linearly from 15 percent for single people whose income is less than $26,250 (and less than $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. Moreover, state marginal tax rates and exemptions differ widely between states. Table 2 displays the current tax rates applicable in different US states and shows that 8 states, including Texas and Florida, do not levy any income tax on their residents. In addition, 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 have a flat rate income tax, in most states, the marginal tax rate increases with income, and there are a variety of tax allowances to which households are entitled.

To measure the tax burden, 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 a 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) and provided by the NBER. 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.

From the output of the TAXSIM program we want to construct a measure of how redistributive the tax system is in each state. If the marginal tax rate was the same for all households in any year-state, then this would be the natural measure of redistributiveness. However, marginal taxes differ substantially across agents even in the same year and state. Furthermore, agents have many exemptions, allowances, and transfers available to them that depend upon their 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 the main feature of interest for this paper: how variation in taxes affects consumers.

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 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.

A problem associated with this measure is that it does not account for heterogeneity amongst household tax rates. For instance, a mean marginal tax rate of 20 per cent in a state and year, could be due to all paying a marginal tax rate of 20 per cent; or 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 the amount of redistribution within the state and year, something that we would like the tax measure to capture. In order to better account for this heterogeneity in taxes, we also construct a more direct measure of how much the tax system redistributes income. This measure is constructed as:

$$1 - \sqrt{\frac{var_{jt}\,(\text{income}_{ijt} - \text{tax liability}_{ijt} + \text{transfers}_{ijt})}{var_{jt}(\text{income}_{ijt})}} \tag{3}$$

where the tax liability is obtained from the TAXSIM program, and i denotes the household. The above measure is computed for each group of households that reside in a given state j in a given year t as one minus the square-root of the ratio of the variance 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 constructed measure would exactly equal the marginal tax rate (and also the average tax rate), and it would not matter which measure was used. Since a larger value implies more redistribution, we name it the income compression measure. Given that the mean marginal tax rate conceals large differences in the households' marginal tax rates, the income compression measure will be our preferred measure of how redistributive the tax system is.

Table 4 displays the two tax measures for the whole of the US and for the 6 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 form 2.2 in Pennsylvania to 6.3 in New York. The second 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 and the correlation between the two measures is 0.81.

5 The Empirical Evidence

The regressions use year-state level grouped data where the measures of tax redistribution vary over time and across states. Cells were 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. Using different cell sizes, or combining one, or three years together, does not qualitatively change the results. Nevertheless, for comparison, some results are reported for a minimum cell size of 100.

Throughout we refer to the mean and standard deviation of consumption as the mean and the 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 (or saving, for which a tobit was ran) was regressed against a cubic polynomial in age, education, family-size, month, year, race, and marital status. Group averages were then constructed from the residuals. We also report results without the first stage controls.

Saving

The effect of taxes on saving is reported in table 5. Panel A shows how the income compression measure (recall equation 4) affects savings, while panel B reports results for the mean marginal tax rate. The results refer to the saving level.[10] Column (1) displays the basic regression, which includes state dummies. The results, surprisingly, show that increasing tax redistributiveness (using either measure) increases the level of saving: this result conflicts with the predictions from the theory. Moreover the results are significant at the 1 percent level. When year dummies are also included in the regression, column (2), the results change. While the income compression measure still shows a positive effect, the coefficient is reduced and is marginally not significant (at the 10 percent level). However, in panel B the effect becomes negative. Columns (3) and (4) instead difference the data, and regress the change in saving against the change in the tax measures. Differencing will remove any linear time trend, which appears in the constant of the differenced equation, and it will also remove the state fixed effect. For both tax measures the effect is now negative. Moreover, the effect is significant for the mean marginal tax rate, at the 1 percent level in column (3) that includes year dummies to control for aggregate shocks, and at the 5 percent level in column (4) that additionally allows for different deterministic trends for each state.

In columns (5) and (6) the minimum cell size is 100 rather than 50. This will reduce the number of observations in the regression, but also the measurement error since the variable of interest is constructed over a larger number of households.[11] The results mirror those in columns (2) and (4), but this time they are never significant. Increasing the minimum size of the cell has raised the standard errors (this is also true for tables 6-8), which could account for the lack of significance. Columns (7) and (8), instead, do not control for the demographic variables before construction of the variable of interest, but again the results are not significant. In columns (9) and (10), the top and bottom 5 percent of observations (ordered by consumption) are removed. There are two possible reasons for removing the top 5 percentile. Firstly, the model may not be a good description of the behavior of the

[10]Using the saving rate (the ratio of saving to disposable income) leads to very similar results.

[11]Results are similar when the minimum size of each cell is either 75 or 120 observations, and this is also true for tables 6-8.

very rich. Carroll (2000) argues that the simplest model that explains the saving behavior of the rich assumes that the well-to-do view the accumulation of wealth as an end in itself. Secondly, the CEX topcodes the responses of the wealthiest households, and it is difficult to reconstruct their real level of consumption or saving given this topcoding. That the data is topcoded is ignored in the other columns. While the results are similar to those in columns (2) and (4), they are again not significant.

One might wonder whether the results are affected by the endogeneity of taxes with respect to saving (and to consumption and inequality). Any change in the tax system may be due to changes in the underlying economy and is thus co-determined with changes in the other variables of interest. To address this problem, we need to use instruments that affect taxes without directly affecting saving (or consumption). Political variables are candidate instruments since they are likely to reflect attitudes towards redistribution, rather than general economic conditions. The variables used are the percent of voters voting for the republican candidate in presidential elections, whether the state governor was a democrat or republican, and who controlled the state legislature.[12] Also included is 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 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 (11)-(13) in table 5 show the results when the tax system is instrumented by the political variables. The results are never significant, and moreover, for the income compression measure of the tax system, panel A, the coefficient is always positive. It is also positive for the mean marginal tax rate measure when state dummies only are included in the regression. The instruments pass the rank test in columns (11) and (12) but not

[12]The percent voting for the republican candidate was the percentage only considering those who voted for either the democratic or the republican candidate, having adjusted for the overall level voting for each candidate at the national level. For the other two measures, independent governors, and split state legislatures were dummied as intermediate. The data were made available by Tim Storey at the National Conference of State Legislatures.

in column (13), due to the low predictive power of the differenced variables. As for the Sargan test, the results are consistent across Panel A and B and show that only in column (13) are the over-identyifing restrictions not clearly rejected. This suggests that the political variables do not do particularly well in instrumenting our tax redistributiveness measures in the regressions for saving.

Overall the results are not clear cut. While column (4), which differences out the fixed effect, includes year dummies, and allows different growth rates in different states, is the preferred regression, and generates a coefficient with the sign predicted from the theory (and is significant for panel B), many of the other regressions either produce a positive and/or statistically insignificant coefficient, hence we are cautious about these results.

Mean Consumption

Table 6 uses mean consumption as the dependent variable. When state dummies are included, column (1), the estimated effect is negative, as the theory predicts, but marginally not significant at the 10 percent level. However, adding year dummies increases the size of the coefficient, and causes the result to be significant for the income compression measure (panel A). When the data are differenced, as in columns (3) and (4), the coefficients are again negative, and now highly significant (at the 1 percent level) in panel A. These results suggest that a more redistributive tax system is reducing average consumption. The same pattern of results is obtained when the minimum size of each cell is 100, columns (5) and (6); when the demographic controls are omitted, columns (7) and (8); and when the data are symmetrically trimmed, columns (9) and (10).

Lastly, columns (11)-(13) investigate the effect of using the political variables as instruments. In contrast to the saving results, 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. When combined with the rank test (shown in table 5), this 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 either 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. One note of caution, however, is that in columns (12) and (13), the estimated coefficient (as well as the standard error) are dramatically increased. Nevertheless, the results are strongly supportive of the hypothesis that a more redistributive tax system does result in lower average consumption.

Consumption Inequality

Results for the standard deviation of log-consumption are reported in table 7. When state effects only are included, column (1), the results, while negative for both measures of the tax system, are not significant. When year fixed effects are added, column (2), the sign in panel A (which uses the income compression measure) is positive. Panel B, by contrast, has a negative and significant effect, consistent with the theory. When the data are differenced, columns (3) and (4), the results show a negative coefficient, which is significant in panel A. Results are similar when the minimum cell size is 100, columns (5) and (6), when the demographic variables are excluded, columns (7) and (8), and when the data are symmetrically trimmed, columns (9) and (10): in all but one case, the estimated coefficient is negative, and in 5 cases this coefficient is significant at the 10 percent level. The final three columns demonstrate the effect of instrumenting with the political variables. The Sargan test is not rejected in Panel A, but is rejected at the 10 percent level in Panel B in levels. This suggests that the political variables are good instruments for the income compression measure, but not for the mean marginal tax rate. Nevertheless, the IV-regression results show that all six estimated coefficients are negative. Moreover, when state effects only are included in column (11), the results are significant at the 5 percent level for both tax measures. 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 significantly reduces the standard deviation of consumption, as the theory predicts.

Tables 6 and 7 show that both the mean and the variance of consumption are reduced when the tax system is more redistributive. The ratio of these variables is investigated in table 8. The results are broadly in line with those reported in table 7. The baseline specification in column (1), which only includes state dummies, shows a negative, but insignificant effect. As before, when year dummies are also included, column (2), the coefficient in panel A is now positive but insignificant, while in panel B the effect is negative and significant. When the data are differenced in columns (3) and (4), the estimated effect is always negative, and is significant at the 10 percent level for the income compression measure. The broad pattern of results is again obtained in columns (5)-(10). When the tax system is instrumented with the political variables in columns (11)-(13), the results of the Sargan test are the same as in table 7: the Sargan test rejects the over-identifying restrictions in columns (11) and (12) for Panel B. Combining these results with the rank test suggests that only Panel A, columns (11) and (12), can safely be interpreted. Nevertheless, all the IV-regressions estimate a negative effect on the coefficient of variation. In column (11), 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 (12), while when the data are also differenced, the coefficients are only significant at the 10 percent level in Panel A. Overall, the results show that the coefficient of variation falls as the tax system becomes more redistributive.

Our interpretation of the results is that making the tax system more redistributive has an ambiguous effect on saving. However, the results suggest that the mean, standard deviation, and coefficient of variation of consumption all fall with the degree of redistribution. With the preferred measure of the tax system (the income compression measure), the results are significant in differences. For the mean, the effect is also significant in levels when both state and year dummies are included. When using the mean marginal tax rate the results are much less clear cut. The evidence from the rank and Sargan test suggests that the most satisfactory regression is for Panel A, columns (11) and (12): the results show that increasing redistribution reduces the mean, standard deviation, and coefficient of variation of consumption.

Except for the saving regressions, the results generally support the theory. The lack of convincing evidence for saving may be due to the CEX being designed as a survey to elicit responses about consumption; saving may be poorly estimated as a result. Unfortunately there is no other survey of saving that also has state information (state information is available in the Survey of Consumer Finances, but only in 1986, and moreover, the sample size is too small to give satisfactory results). Therefore, the effect on saving remains an open issue.

6 Conclusions

The paper attempts to assess the trade-off between efficiency and equity: households like more equality, but may not be prepared to pay the cost if there is a substantial welfare loss due to distortions in the incentives to save and invest. The theoretical part of the paper models a stylized economy that encompasses many of the important features needed to make an assessment of this trade-off. The calibration exercise, using standard assumptions about the utility function, the persistence of labor income shocks, and the presence of credit constraints demonstrates that raising taxes lowers saving, mean consumption and also both the standard deviation, and the coefficient of variation of consumption.

Are the theoretical results consistent with the data? Ideally, one would like to have several identical economies and exogenously vary tax rates to observe how the variables of interest change. However, this is not practically possible. Instead, we use variation between US states to empirically evaluate the model. Differences among households between states are likely to be much smaller than differences between, for instance, countries, hence any test of the theory can more convincingly be done by exploiting the variation between states. However, one needs to control for some differences between states. This is done in several ways: we control by including state and time dummies in the regression, we difference the data to remove any state fixed effect, and we instrument the tax system using political variables. In the data, there is evidence that the mean, the standard deviation and the coefficient of variation of consumption are indeed decreasing in the tax redistributiveness measure, whereas the evidence on saving is more ambiguous.

The fact that the data are broadly consistent (except for saving) with the theory lends support to the implications of the model; namely that raising tax redistributiveness increases equity but reduces efficiency. Interestingly, the result on the coefficient of variation suggests that equity increases more than efficiency decreases. This suggests that the “marginal rate of transformation” between equity and efficiency is less than one. Governments decide the degree of redistribution on the basis of voters’ preferences, given the trade-off between equity and efficiency, which determines where the economy lies on the equity-efficiency locus. This, however, is beyond the scope of this paper, whose aim is to describe the equity-efficiency trade-off and provide the input for future studies that want to describe how the optimal combination of equity and efficiency depends on preferences.

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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
Arkansas	1.0	7.0	20*	40*	20*
California	1.0	9.3	72*	142*	227*
Colorado	4.63	4.63		none	
Connecticut	3.0	4.5	12,000	24,000	0
Delaware	2.2	5.95	110*	220*	110*
Florida	no state tax				
Georgia	1.0	6.0	2,700	5,400	2,700
Hawaii	1.5	8.5	1,040	2,080	1,040
Idaho	2.0	8.2	2,900	5,800	2,900
Illinois	3.0	3.0	2,000	4,000	2,000
Indiana	3.4	3.4	1,000	2,000	1,000
Iowa	0.36	8.98	40*	80*	40*
Kansas	3.5	6.45	2,250	4,500	2,250
Kentucky	2.0	6.0	20*	40*	20*
Louisiana	2.0	6.0	4,500	9,000	1,000
Maine	2.0	8.5	2,850	5,700	2,850
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
Montana	2.0	11.0	1,610	3,220	1,610

*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 2: (cont.) State Individual Income Tax Rates in the US

State	Tax Rates		Exemptions		
	low	high	single	married	dependents
Nebraska	2.51	6.68	91*	182*	91*
Nevada	no state tax				
New Hampshire	taxes unearned income only				
New Jersey	1.4	6.37	1,000	2,000	1,500
New Mexico	1.7	8.2	2,900	5,800	2,900
New York	4.0	6.85	-	-	1,000
North Carolina	6.0	7.75	2,500	5,000	2,500
North Dakota	2.67	12.0	2,900	5,800	2,900
Ohio	0.691	6.98	1,050	2,100	1,050
Oklahoma	0.5	6.75	1,000	2,000	1,000
Oregon	5.0	9.0	132*	264*	132*
Pennsylvania	2.8	2.8		none	
Rhode Island	25.5% of federal taxes				
South Carolina	2.5	7.0	2,900	5,800	2,900
South Dakota	no state tax				
Tennessee	taxes unearned income only				
Texas	no state tax				
Utah	2.3	7.0	2,175	4,350	2,174
Vermont	24% of federal taxes				
Virginia	2.0	5.75	800	1,600	800
Washington	no state tax				
West Virginia	3.0	6.5	2,000	4,000	2,000
Wisconsin	4.6	6.75	700	1,400	400
Wyoming	no state tax				
Dist. Columbia	5.0	9.0	1,370	2,740	1,370

*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	-	-	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	-	-	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 saving (standard errors in parentheses).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
A: *tax rate*	0.110	0.021	-0.048	-0.106	0.261	-0.209	-0.053	-0.048	0.074	-0.149	0.090	0.458	1.377
	(0.033)	(0.103)	(0.154)	(0.163)	(0.277)	(0.324)	(0.099)	(0.114)	(0.086)	(0.134)	(0.096)	(0.461)	(1.715)
constant	0.040	0.072	-0.002	0.028	0.002	-0.001	0.007	0.025	0.032	-0.007	0.077	-0.071	0.006
	(0.014)	(0.031)	(0.002)	(0.005)	(0.071)	(0.012)	(0.030)	(0.005)	(0.028)	(0.007)	(0.020)	(0.141)	(0.025)
Sargan test											13.61	9.88	4.55
p-value											(0.0183)	(0.0785)	(0.4732)
Rank test											8.36	11.24	1.12
p-value											(0.000)	(0.000)	(0.353)
B: *tax rate*	0.080	-0.143	-0.281	-0.259	-0.095	-0.081	-0.083	-0.094	0.002	-0.171	0.004	-0.184	-1.021
	(0.026)	(0.087)	(0.106)	(0.123)	(0.122)	(0.175)	(0.085)	(0.119)	(0.073)	(0.091)	(0.043)	(0.131)	(0.747)
constant	0.068	0.139	-0.007	0.027	0.110	-0.000	0.052	0.027	0.069	-0.004	0.092	0.123	-0.000
	(0.015)	(0.028)	(0.003)	(0.006)	(0.033)	(0.013)	(0.027)	(0.006)	(0.025)	(0.007)	(0.014)	(0.041)	(0.019)
Sargan test											13.55	10.79	7.54
p-value											(0.019)	(0.056)	(0.1836)
Rank test											2.42	8.51	1.18
p-value											(0.038)	(0.000)	(0.323)
Dummies: state	yes	yes		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
year		yes	yes	yes	yes	yes	yes	yes	yes	yes		yes	yes
diff.			yes	yes		yes		yes		yes			yes
pol.											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 *pol.* refers to instrumenting the tax system with political variables. All regressions, except columns (7) and (8) control for household characteristics. The cell size was 50, (100 in columns (5) and (6)), while columns (9) and (10) symmetrically trimmed the top and bottom 5 percent of observations. Huber standard errors are reported.

Table 6: The effect of taxes on mean log-consumption (standard errors in parentheses).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel A:													
tax rate	-0.177	-0.706	-1.071	-1.145	-0.819	-1.152	-0.996	-1.498	-0.294	-0.698	-0.857	-3.547	-3.951
	(0.110)	(0.318)	(0.354)	(0.395)	(0.384)	(0.468)	(0.366)	(0.439)	(0.254)	(0.366)	(0.284)	(1.522)	(2.226)
p-value	0.111	0.028	0.003	0.004	0.035	0.015	0.007	0.001	0.248	0.059	0.003	0.021	0.078
constant	7.195	7.385	0.020	-0.171	7.734	-0.047	6.884	-0.170	7.457	-0.022	7.659	8.530	-0.127
	(0.066)	(0.123)	(0.014)	(0.023)	(0.134)	(0.001)	(0.142)	(0.030)	(0.090)	(0.018)	(0.090)	(0.460)	(0.100)
Sargan test											4.471	4.764	4.457
p-value											(0.484)	(0.445)	(0.486)
Panel B:													
tax rate	-0.146	-0.305	-0.186	-0.148	-0.370	-0.316	-0.268	0.085	-0.063	-0.040	-0.610	-1.896	-0.807
	(0.090)	(0.329)	(0.300)	(0.436)	(0.361)	(0.525)	(0.381)	(0.493)	(0.255)	(0.350)	(0.200)	(0.800)	(3.713)
p-value	0.105	0.355	0.641	0.735	0.307	0.548	0.482	0.863	0.803	0.909	0.003	0.019	0.828
constant	7.173	7.228	0.012	-0.190	7.592	-0.049	6.621	-0.193	7.387	-0.020	7.590	8.026	-0.194
	(0.062)	(0.106)	(0.014)	(0.022)	(0.126)	(0.003)	(0.123)	(0.029)	(0.089)	(0.018)	(0.075)	(0.243)	(0.088)
Sargan test											5.068	7.311	9.999
p-value											(0.408)	(0.198)	(0.075)
Dummies:													
state	yes	yes		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
year		yes	yes	yes	yes	yes	yes	yes	yes	yes		yes	yes
diff.			yes	yes		yes		yes		yes			yes
pol.											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 *pol.* refers to instrumenting the tax system with political variables. All regressions, except columns (7) and (8) control for household characteristics. The cell size was 50, (100 in columns (5) and (6)), while columns (9) and (10) symmetrically trimmed the top and bottom 5 percent of observations. Huber standard errors are reported.

Table 7: The effect of taxes on the standard deviation of log-consumption (standard errors in parentheses).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel A:													
tax rate	-0.055	0.043	-0.756	-0.851	-0.022	-0.709	0.105	-0.849	-0.078	-0.442	-0.461	-1.890	-3.267
	(0.084)	(0.237)	(0.362)	(0.370)	(0.307)	(0.449)	(0.274)	(0.472)	(0.134)	(0.210)	(0.209)	(1.106)	(1.786)
p-value	0.509	0.855	0.038	0.023	0.941	0.118	0.702	0.074	0.561	0.037	0.028	0.089	0.069
constant	0.514	0.477	0.038	0.040	0.503	-0.006	0.500	0.076	0.410	-0.045	0.596	1.052	0.078
	(0.050)	(0.092)	(0.011)	(0.017)	(0.107)	(0.001)	(0.106)	(0.018)	(0.047)	(0.010)	(0.066)	(0.334)	(0.080)
Sargan test											8.961	4.499	5.310
p-value											(0.111)	(0.480)	(0.379)
Panel B:													
tax rate	-0.106	-0.467	-0.032	-0.181	-0.731	-0.805	-0.534	-0.141	-0.165	-0.229	-0.307	-0.555	-2.834
	(0.068)	(0.240)	(0.376)	(0.391)	(0.276)	(0.422)	(0.277)	(0.437)	(0.134)	(0.219)	(0.145)	(0.551)	(3.250)
p-value	0.119	0.053	0.931	0.643	0.009	0.059	0.056	0.746	0.219	0.297	0.036	0.315	0.384
constant	0.517	0.613	0.032	0.026	0.720	-0.003	0.674	0.062	0.435	-0.046	0.555	0.651	0.010
	(0.046)	(0.077)	(0.011)	(0.017)	(0.096)	(0.003)	(0.089)	(0.017)	(0.047)	(0.010)	(0.054)	(0.167)	(0.077)
Sargan test											10.656	9.945	8.620
p-value											(0.059)	(0.077)	(0.125)
Dummies:													
state	yes	yes		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
year		yes	yes	yes	yes	yes	yes	yes	yes	yes		yes	yes
diff.			yes	yes		yes		yes		yes			yes
pol.											yes	yes	yes

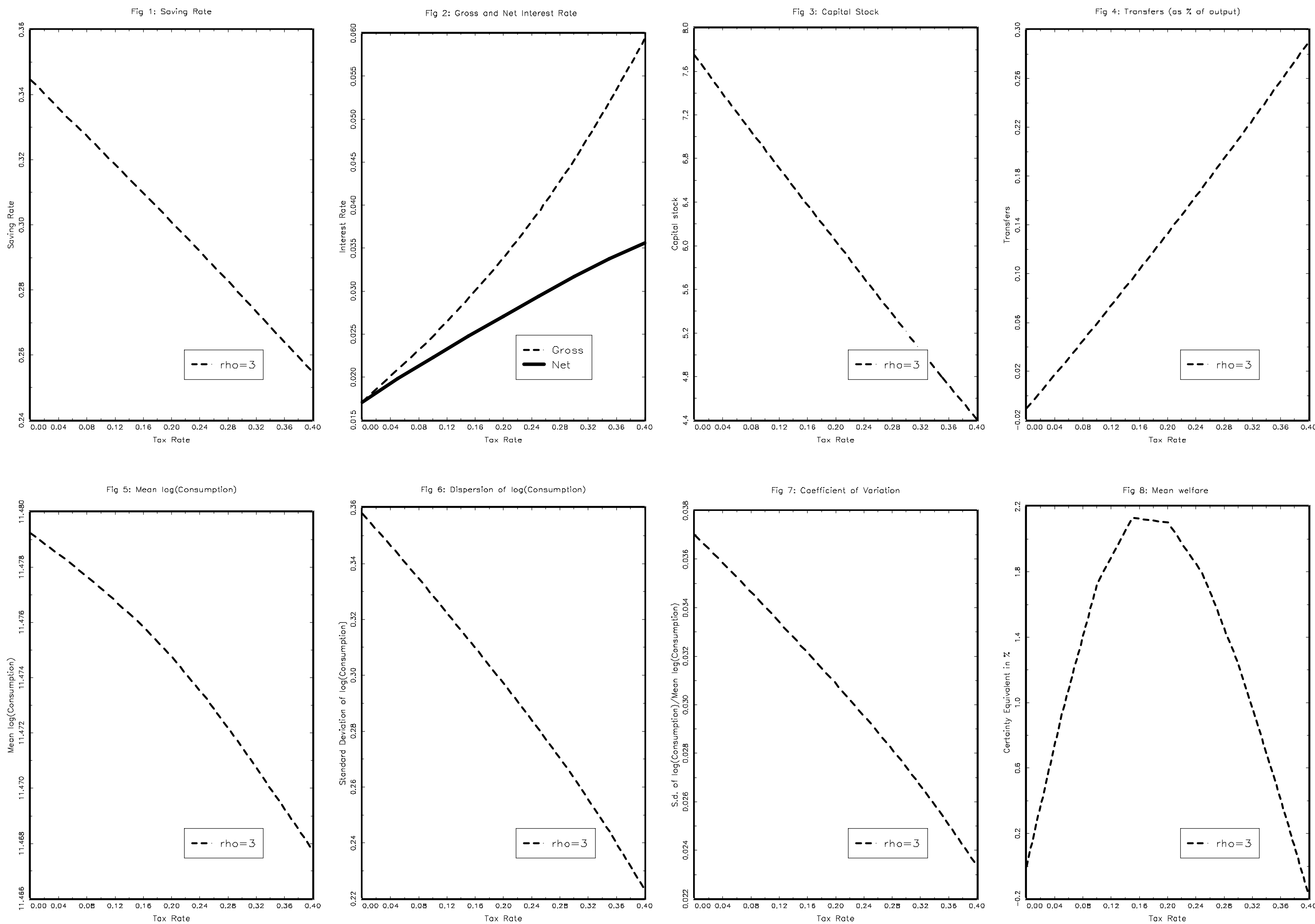
Panel A refers to regressions involving the ratio of the standard deviation of after tax income to the standard deviation of before tax income, while Panel B refers to using the mean marginal tax rate. Here *state* refers to the inclusion of state dummies, *year* refers to the inclusion of year dummies, *diff.* refers to whether the data was first-differenced, while *pol.* refers to instrumenting the tax system with political variables. All regressions, except columns (7) and (8) control for household characteristics. The cell size was 50, (100 in columns (5) and (6)), while columns (9) and (10) symmetrically trimmed the top and bottom 5 percent of observations. Huber standard errors are reported.

Table 8: The effect of taxes on the coefficient of variation of log-consumption (standard errors in parentheses).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel A:													
tax rate	-0.045	0.090	-0.689	-0.779	0.031	-0.635	0.180	-0.732	-0.064	-0.410	-0.412	-1.683	-3.001
	(0.083)	(0.236)	(0.357)	(0.364)	(0.307)	(0.440)	(0.277)	(0.476)	(0.135)	(0.210)	(0.206)	(1.080)	(1.727)
p-value	0.586	0.704	0.055	0.034	0.918	0.152	0.702	0.126	0.634	0.053	0.047	0.121	0.084
constant	0.518	0.468	0.037	0.049	0.470	-0.002	0.480	0.090	0.399	-0.045	0.571	0.976	0.085
	(0.050)	(0.091)	(0.011)	(0.017)	(0.107)	(0.001)	(0.107)	(0.017)	(0.048)	(0.010)	(0.065)	(0.326)	(0.078)
Sargan test											9.245	4.992	5.749
p-value											(0.100)	(0.417)	(0.331)
Panel B:													
tax rate	-0.099	-0.452	-0.015	-0.168	-0.711	-0.783	-0.522	0.143	-0.163	-0.227	-0.272	-0.446	-2.761
	(0.067)	(0.239)	(0.374)	(0.387)	(0.277)	(0.415)	(0.280)	(0.442)	(0.135)	(0.217)	(0.143)	(0.550)	(3.181)
p-value	0.145	0.061	0.966	0.664	0.012	0.062	0.064	0.745	0.230	0.296	0.060	0.418	0.387
constant	0.523	0.616	0.032	0.036	0.698	0.000	0.676	0.077	0.428	-0.047	0.534	0.604	0.021
	(0.046)	(0.077)	(0.011)	(0.016)	(0.097)	(0.002)	(0.090)	(0.017)	(0.047)	(0.010)	(0.053)	(0.167)	(0.075)
Sargan test											10.763	9.769	8.435
p-value											(0.056)	(0.082)	(0.134)
Dummies:													
state	yes	yes		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
year		yes	yes	yes	yes	yes	yes	yes	yes	yes		yes	yes
diff.			yes	yes		yes		yes		yes			yes
pol.											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 *pol.* refers to instrumenting the tax system with political variables. All regressions, except columns (7) and (8) control for household characteristics. The cell size was 50, (100 in columns (5) and (6)), while columns (9) and (10) symmetrically trimmed the top and bottom 5 percent of observations. Huber standard errors are reported.

Single discount factor economy (rho=3)



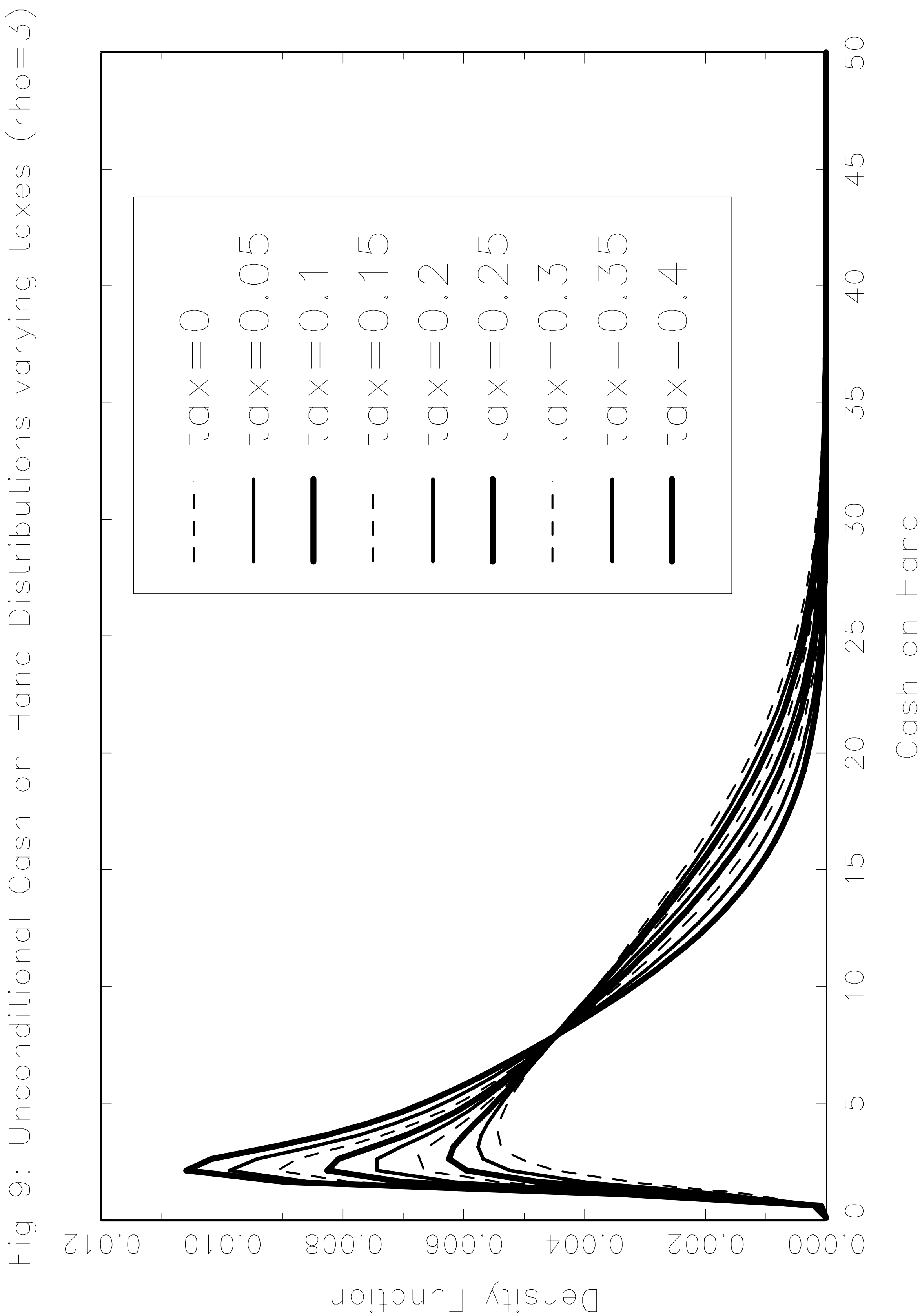


Fig 9: Unconditional Cash on Hand Distributions varying taxes (rho=3)
tax=0
tax=0.05
tax=0.1
tax=0.15
tax=0.2
tax=0.25
tax=0.3
tax=0.35
tax=0.4
Density Function
0.000
0.002
0.004
0.006
0.008
0.010
0.012
Cash on Hand
0
5
10
15
20
25
30
35
40
45
50

Economy with discount rate heterogeneity (rho=3)

Fig 10: Unconditional Wealth Distributions varying taxes (impatient)

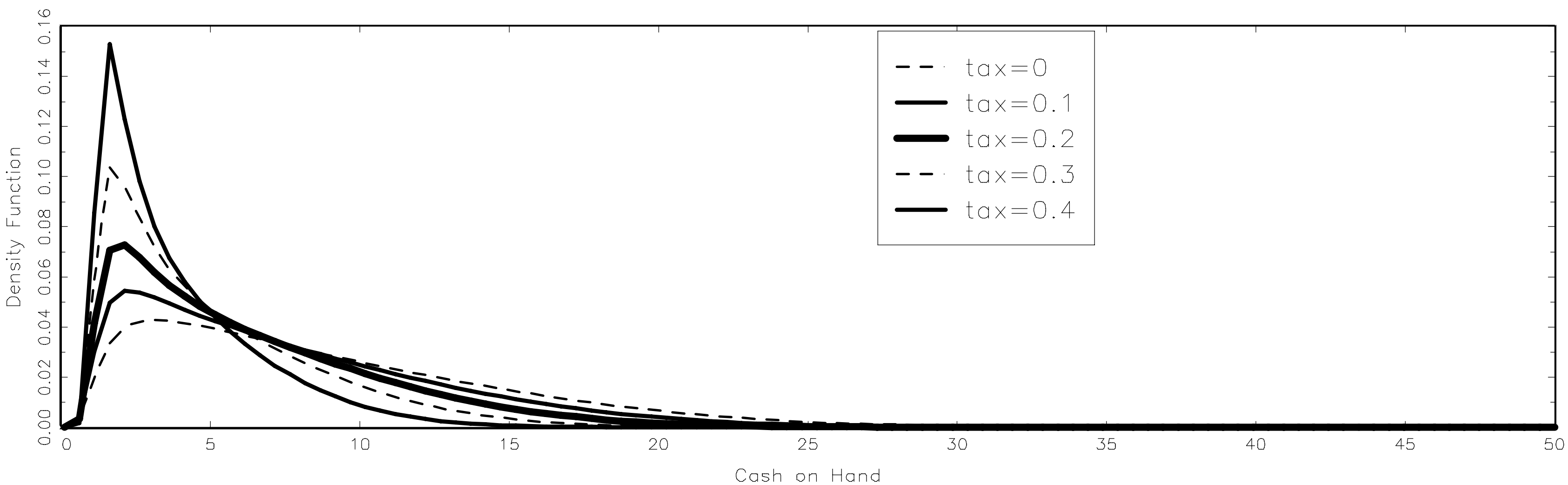
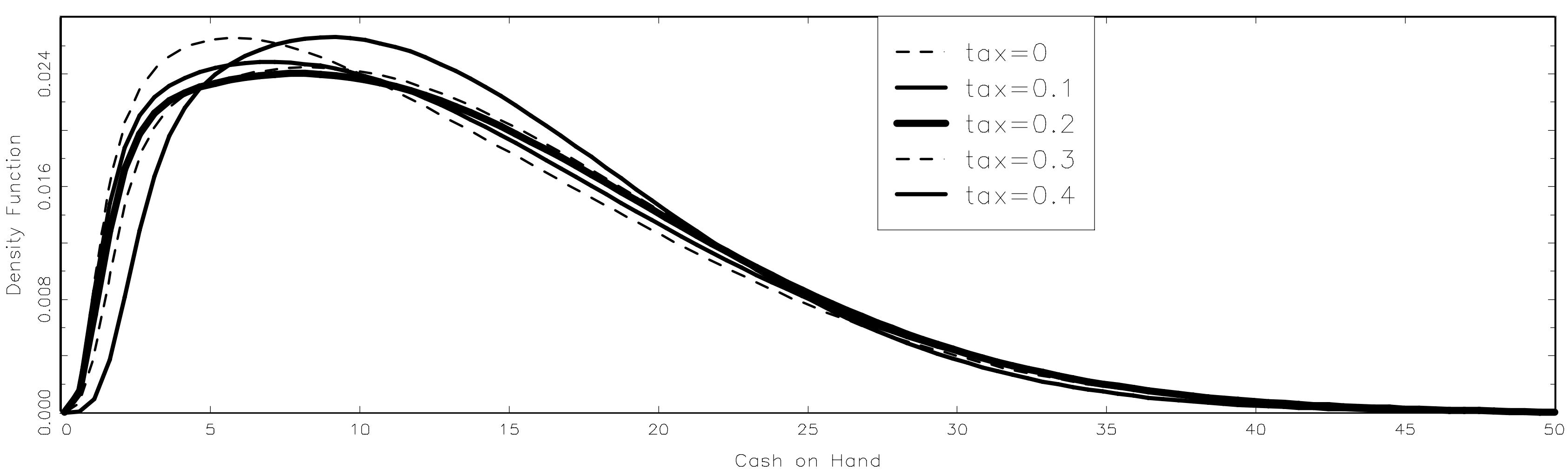


Fig 11: Unconditional Wealth Distributions varying taxes (patient)



Heterogeneity in Discount Factor Economy (rho=3)