Wealth vs. Income Taxes in a Model of Credit Constraints and Inequality

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Abstract

We compare the performance of net wealth and income taxes in a macroeconomic model with two types of agents: poor households, which are credit constrained, and unconstrained wealthier households. The wealth tax does promote greater wealth and consumption equality, and often results in less volatility than an income tax. It performs abysmally, however, under any reasonable social welfare function because its steady state exhibits too little consumption, too few government expenditures, and too much labor supply. The resulting welfare loss of using a wealth tax instead of an income tax is equivalent to forgoing as much as 50% of steady state consumption. Our results are robust to whether taxation is flat or progressive, whether tax revenue is used to finance a public good or to provide transfer payments, and to whether the capital stock is fixed or endogenous. Furthermore, if a wealth tax endogenously responds to either income or wealth inequality, then it frequently results in indeterminacy of equilibrium.

Keywords: wealth taxes, fiscal policy, credit constraints, indeterminacy.

JEL Classification: E22, E32, E62, O40.

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The past decade has witnessed increased attention paid to economic inequality (e.g. wealth, income, consumption), especially within developed economies. This attention is notably not limited to the academic literature. Thomas Pikkety's *Capital in the Twenty-First Century* (2014) is perhaps the best example; becoming the rare 700 page mathematical tome to manage a sustained run as the best selling book on *Amazon.com*.[1] Piketty (2014) makes numerous contributions. He gathers new data that demonstrates rising inequality and offers a macroeconomic model that tends toward considerable inequality. The focus of this paper is one of his policy recommendations that suggests some type of global wealth tax as a means to reduce inequality.[2] Piketty and Saez (2012 and 2013) advocate for such a tax, specifically imposed on inheritances.

In a macroeconomic model with heterogeneous agents, we compare a wealth tax to the more common income tax. We find that while a wealth tax is more effective both at reducing inequality (especially consumption inequality) and usually results in less volatility, it almost always performs worse than an income tax for reasonable social welfare functions that range between Max-Min and Utilitarian. The steady state that occurs under a wealth tax (where the policy maker chooses the tax rate to maximize social welfare) exhibits less consumption, fewer government services, and more labor supply than the steady state under an income tax. These effects easily dominate those of reduced inequality and volatility making a wealth tax undesirable. The welfare loss of using a wealth tax, measured as the equivalent loss in steady state consumption, i as high as 50%. This result is very robust. The only case we examine where a wealth tax outperforms an income tax is when borrowers' debts are allowed to significantly exceed their collateral.

Pikkety's (2014) advocacy of a wealth tax relies a very general model without much optimization. This paper compares a wealth tax to an income tax in a model with strong micro-foundations by using a Real Business Cycle type model. We add heterogeneity and inequality using the framework of Kiyotaki and Moore (1997). Here, there are two types of households with identical preferences except that one has a higher discount factor. Patient households (high discount factors) lend to impatient households (low discount factors) and the latter must collateralize their loans by ensuring that the recoverable expected value of physical capital equals their debt obligations. This type of model has become very popular in the past decade, mostly to show how some shocks may be amplified or propagated by the credit constraint that arises from the need to collateralize debt.[3] Although inequality

[1] Krueger, Perri, Pistaferri, and Violante (2010) introduce a special issue of the *Review of Economic Dynamics* that documents generally rising inequality within nine North American and European economics. Heathcote, Perri, and Violante (2010), for example, document rising wage inequality in the United States between 1967 and 2006, while Blundell and Etheridge (2010) find rising income, earnings, and consumption inequality in Britain since 1978.

[2] In his book, Pikkety uses capital and wealth interchangably. We later show in our model that taxes on only phyical capital perform similarly to more general wealth taxes.

[3] See, for example, Iacoviello (2005) and Mendicino (2012).

arises naturally in the model, this setup has not been used to examine macroeconomic issues regarding inequality.

We add both income taxes and net wealth taxes to this type of model. Tax revenue is used either to finance a public good or to provide transfer payments to poorer households. When taxes are very low, patient households exhibit much higher steady state consumption, capital, income, and utility than impatient households. We do not assume that social welfare depends directly on inequality. Rather, we assume that it ranges between a Utilitarian function that simply sums steady state utility, and a Max-Min function that takes the minimum level of steady state utility (typically impatient households' utility) across households.

Initially, raising the wealth tax both reduces inequality (of all types) and improves welfare. The optimal wealth tax rate may be as high as 1.3% (when the public good is highly valued and social welfare is Max-Min). Even higher levels of the wealth tax further reduce inequality and very high levels (over 10%) are able to largely eliminate consumption inequality. They do so, however, by making wealthy households worse off faster than they make poorer households worse off and are thus Pareto sub-optimal. As expected, the wealth tax reduces both agents' capital and consumption levels.

We compare the results with a wealth tax to the model with only an income tax at the steady state. Because the income tax is much more narrow, optimality (within each type of tax, not across types) requires a much higher rate, possibly over 30%. In contrast to the wealth tax, a higher income tax causes only a small decline in wealth inequality and has a negligible effect on consumption inequality. This result does not suggest, however, that the income tax is worse than the wealth tax. We show that, as long as the public good is valued, the optimal wealth tax yields much worse steady state welfare than the optimal income tax. An income tax, optimally chosen, increases both types of households' utility relative to a wealth tax. Measured in terms of equivalent lost steady state consumption, as the public good becomes equally as valued as private consumption, the use of a wealth tax instead of an income tax causes a welfare loss between 20% and 50%. The poor performance of the wealth tax is robust to whether the tax schedule is progressive or flat, whether tax revenue is used only to provide the public good or if it also used to make transfer payments, whether capital is fixed or endogenous, and whether social welfare is Utilitarian or Min-Max. The only case we find where the wealth tax yields higher steady state social welfare than the income tax is when we relax the collateralization approach of Kiyotaki and Moore (1997) to allow borrowers to go underwater on their loan obligation. Here, a wealth tax prevents borrowers from becoming excessively leveraged, allowing them to enjoy higher steady state consumption.

We then examine the business cycle dynamics of the model under each tax regime. Assuming that the tax rate is exogenous, we find that both tax regimes exhibit similar responses to productivity

shocks, although the response is generally more drawn out under an income tax. Because the wealth tax operates primarily by taxing capital however, and capital is slow to adjust in the model, we find that a shock to the wealth tax rate induces a smaller response than shocks to the income tax rate. Overall, the model is more stable under the wealth tax. Despite exhibiting two properties that are generally considered desirable - greater stability and less inequality- the wealth tax is typically highly undesirable due to the magnitude of the steady state results.

We next consider whether different fiscal policy rules may result in indeterminacy of equilibrium. Indeterminacy is of interest in models of the business cycle because it allows extraneous self-fulfilling expectational errors to add volatility and persistence to the model, usually resulting in a welfare loss. We find two important results. First, we identify a new source of indeterminacy by examining tax rates that endogenously repond to inequality. Most strikingly, we find that a wealth tax that automatically rises in response to increased (current or expected future) income or wealth inequality often results in indeterminacy. We find no such result for an income tax. This result illustrates a further disadvantage of the wealth tax. Second, we examine another source of indeterminacy, first identified by Schmitt-Grohe and Uribe (1997), who find that if government expenditures are exogenous and tax rates endogenously adjust to balance the budget, then indeterminacy frequently arises. We find that this type of indeterminacy does not occur in our model under a wealth tax, but does under an income tax. A wealth tax may thus be more stable than an income tax under a balanced budget, possibly mitigating some of the disadvantage from the less desirable steady state.

In addition to reducing inequality, other arguments have been made in favor of a wealth tax. First, because national wealth vastly exceeds national income, a much lower rate will likely yield the same revenue as an income tax. It is therefore not obvious that a wealth tax, optimally designed, will be more distortionary than an income tax.[4] This paper considers this argument explicitly by assuming that policy makers choose tax rates to maximize a social welfare function for each type of tax. We thus compare the wealth tax that maximizes welfare (among all wealth tax rates) using a relatively low rate to an income tax that maximizes welfare (among all income tax rates) using a much higher tax rate. Second, it may be argued that wealth holders benefit most directly from governmental protection of property rights and that fairness thus dictates that they should therefore bear most of the tax burden.[5] This paper does not directly deal with this argument but instead evaluates optimal fiscal policy using a social welfare function.

The literature on economic inequality has also suggested that too much inequality may inhibit

[4]Dugger (1980) supports a wealth tax in order to reduce inequality and advocates for an 8% rate with a substantial standard deduction. Section 2 shows that in this model, such a high rate has disastrous effects on social welfare.

[5]Schnellenbach (2012) discusses this argument in greater detail.

both the formation of and persistence of democracy.[6] This paper does not examine this issue. Instead, we assume the policy maker maximizes social welfare without specifying the political process that yields this outcome.

Related Literature

Comprehensive taxes on net wealth are relatively uncommon. As documented by Schnellenbach (2012), only France, Norway, and Switzerland among OECD countries currently use them, although other European nations have recently abolished theirs. Rates tend to be below 1% and the tax usually applies only to households with high level of wealth. Many other countries, however, have partial wealth taxes. This includes the United States where real estate wealth taxes are widely used to fund public schools.

Because most countries rely primarily on income taxes, the literature on wealth taxes is relatively small. Consistent with the results of this paper, Hansson (2010) finds robust empirical support that European countries that used a wealth tax reduced their macroeconomic performance, albeit by a fairly small magnitude. Schnellenbach (2012) argues against a wealth tax on both theoretical and empirical grounds. A few papers provide cases in which a wealth tax is desirable. Saez and Piketty (2012 and 2013) do so in the context of inheritance taxes.[7] Ihori (2001) adds a wealth tax to an endogenous growth model and finds ambiguous effects on the growth rate.

A much larger literature examines taxation on capital income instead of wealth.[8] Judd (1985) and Chamley (1986) show that in a standard infinite horizon model, the optimal tax on capital income is zero, strongly suggesting that the optimal tax on capital wealth is also zero. Several papers find conditions where this result no longer holds. Most notably, Aiyagari (1995) finds that with credit constraints, a key feature of the present paper, the optimal tax rate on capital income is positive in a Bewley (1986) type model.[9]

The paper is organized as follows. Section 1 develops the theoretical model. Section 2 then analyzes the steady state properties under both wealth and income taxes. It also considers four extensions of the model: progressive taxation, allowing transfer payments to poorer households, varying access

[6] See, for example, Boix (2003), and Acemoglu and Robinson (2006).

[7] In our model, wealth taxes on bonds and capital are isomorphic to inheritance taxes if we interpret the infinite horizon framework as actually consisting of agents who live for just one period but who are perfectly altruistic towards their children. Cagetti and De Nardi (2009), examine the estate tax in the United States and find that it has caused a small but significant reduction in output.

[8] In some settings, a wealth tax focused on capital is similar to a capital income tax with a much higher tax rate. In the present paper, only the wealth tax impacts borrowers' credit constraint and the comparison is thus less apt.

[9] Uhlig and Yanagawa (1996) provide another example using an endogenous growth model. Here, if the older households possess most capital, and if taxes finance fixed government expenditures, then a capital income tax may reduce income taxes and thus incentivize both net saving and saving among younger households.

to credit, and fixing the capital stock. Section 3 linearizes the model and compares its dynamics under each type of tax. Section 4 concludes.

1 Model

Because the main motivation for a wealth tax appears to be based on high levels of inequality, we analyze the effects of taxation using a type of macroeconomic model that is adept at yielding high levels of income, consumption, and wealth inequality. In this framework, first developed by Kiyotaki and Moore (1997), there are two types of agents who differ only in their discount factors. Patient households, defined as having the higher discount factor, lend to impatient households who are required to fully collateralize their loans so that the value of their assets, in expectation, matches the recoverable portion of their debt. At the steady state, this credit constraint binds and impatient households borrow up to the recoverable expected value of their assets. As a result, impatient households usually have less wealth, income, and consumption than patient households.

This modeling approach has become very popular in macroeconomics over the past two decades. It has mostly been used, however, to show how the credit constraint either amplifies or dampens macroeconomic shocks. One innovation of the present paper is to use this model's inherent heterogeneity to examine the effects of policy on inequality.

Because our focus is on tax policy, we rely on a Real Business Cycle version of this model that omits nominal rigidities. The resulting model, without taxes, is closest to that of Mendicino (2012), who uses a similar model to show that shocks are most amplified when it is moderately costly for lenders to recover a defaulted borrower's collateral.

A continuum of impatient households exists on the unit interval. The representative impatient household, denoted Agent 1 throughout, solves the following optimization problem:

$$Max_{c_{1t},b_{1t},l_{1t}} \quad E_t\left[\sum_{i=0}^{\infty}\beta_1^i\left(\frac{c_{1t+i}^{1-\sigma}}{1-\sigma}+\omega\frac{G_{t+i}^{1-\psi}}{1-\psi}-\chi\frac{l_{1t+i}^{\eta}}{\eta}\right)\right] \tag{1.1}$$

s.t

$$c_{1t}+k_{1t}-(1-\tau_{kt})k_{1t-1}=(1-\tau_{yt})A_tk_{1t-1}^{\alpha}l_{1t}^{1-\alpha}+b_t-R_{t-1}(1-\tau_{bt})b_{t-1}+T_{1t} \tag{1.2}$$

$$Y_{1t}=A_tk_{1t-1}^{\alpha}l_{1t}^{1-\alpha} \tag{1.3}$$

$$R_tb_t\leq\gamma E_t[(1-\tau_{kt+1})k_{1t}] \tag{1.4}$$

In addition to obtaining utility from consumption (c_{1t}) and disutility from labor (l_{1t}), impatient households receive utility from a public good (G_t) that is potentially financed through tax revenues. The parameter ω indicates the weight placed on the public good. We include this public good because any analysis of optimal tax policy must consider how government spending is financed and how it affects utility.[10] The variable T_{1t} captures lump sum transfers.

The budget constraint, (1.2), includes taxes on income (τ_y), capital (τ_k), and bonds (τ_b). Notably, the latter two taxes are not on capital and bond income, but are on capital and bond wealth. The variable, b_t is defined as impatient household debt to patient households and is positive around the steady state. $R_t - 1$ is the real interest rate. For simplicity, we assume that agents are producer-consumers subject to a standard Cobb-Douglas production function, (1.3), with a common productivity shock, A_t. We assume that this shock follows a standard AR(1) process:

$$A_t = A_{t-1}^{\rho} e_t \tag{1.5}$$

where the log of e_t is mean-zero white noise.

Impatient households are also subject to the credit constraint, (1.4). This condition states that impatient households' after tax capital stock must be expected to be sufficiently large to cover their debt payments in period $t + 1$. By subtracting capital taxes, we assume that the government collects its obligations before lenders do. The parameter γ determines how much collateral must be held. This parameter is often interpreted as reflecting the ease with which lenders may recover collateral where $1 - \gamma$ is the fraction of the debt lost in the recovery process.

Because we assume a single productive sector where output can be converted into either the consumption good or capital, the price of capital (later denoted as q_t in Subsection 2.5) is necessarily equal to 1. Later, in Subsection 2.5, we fix the capital stock which endogenizes capital's price and show that a wealth tax performs even worse than with endogenous capital.

The model has a pair of standard features in the literature. First, the credit constraint is binding in the neighborhood of the steady state.[11] Second, default never occurs, rather the threat of default is sufficient to motivate the credit constraint.

Optimization yields a set of first order conditions:

$$c_{1t}^{-\sigma} = E_t[\beta_1 R_t (1 - \tau_{bt+1}) c_{1t+1}^{-\sigma}] + R_t \lambda_t \tag{1.6}$$

[10] Prescott (2003), for example, assumes that taxes finance government expenditures which then provide no utility. The optimal tax rate is then trivially zero.

[11] This result is easily proven by examining both agents' first order conditions. See Iacoviello (2005) for an example.

$$c_{1t}^{-\sigma} = E_t[\beta_1(1-\tau_{yt+1})c_{1t+1}^{-\sigma}A_{t+1}\alpha k_{1t}^{\alpha-1}l_{1t+1}^{1-\alpha}] + E_t[\beta_1(1-\tau_{kt+1})c_{1t+1}^{-\sigma}] + E_t[\gamma(1-\tau_{kt+1})\lambda_t] \quad (1.7)$$

$$(1-\alpha)A_t k_{1t-1}^{\alpha} l_{1t}^{-\alpha}(1-\tau_{yt})c_{1t}^{-\sigma} = \chi l_{1t}^{n-1} \quad (1.8)$$

Equation (1.6) represents impatient households' bond demand. The first two terms simply equate the ordinary benefits and costs of increasing consumption by one unit and financing it through increased bond debt. Such an action, however, also tightens the credit constraint by R_t units. The final term captures this cost where λ_t is the Lagrange multiplier associated with the credit constraint. Equation (1.7) reflects impatient households' capital demand and (1.8) is an ordinary labor supply equation.

The representative patient household, denoted Agent 2 throughout, faces a similar problem:

$$Max_{c_{2t},b_{2t},l_{2t}} \quad E_t\left[\sum_{i=0}^{\infty}\beta_2^i\left(\frac{c_{2t+i}^{1-\sigma}}{1-\sigma} + \omega\frac{G_{t+i}^{1-\psi}}{1-\psi} - \chi\frac{l_{2t+i}^{\eta}}{\eta}\right)\right] \quad (1.9)$$

s.t

$$c_{2t} + k_{2t} - (1-\tau_{kt})k_{2t-1} = (1-\tau_{yt})A_t k_{2t-1}^{\alpha} l_{2t}^{1-\alpha} - b_t + R_{t-1}(1-\tau_{bt})b_{t-1} + T_{2t} \quad (1.10)$$

$$Y_{2t} = A_t k_{2t-1}^{\alpha} l_{2t}^{1-\alpha} \quad (1.11)$$

There are a few differences between patient households' problem and that of impatient households. First, their preferences are identical, including in how they value the public good, except that patient households have a higher discount factor, $\beta_2 > \beta_1$. Second, although patient households are credit constrained as well, we suppress this condition because it never binds around the steady state. Third, the sign on b_t is reversed in (1.10) because debt is defined as impatient households' obligations to patient households.

Optimization then yields three first order conditions that differ from (1.6)-(1.8) only in the lack of a Lagrange multiplier and the sign on debt:

$$c_{2t}^{-\sigma} = E_t[\beta_2 R_t(1-\tau_{bt+1})c_{2t+1}^{-\sigma}] \quad (1.12)$$

$$c_{2t}^{-\sigma} = E_t[\beta_2(1-\tau_{yt+1})c_{2t+1}^{-\sigma}A_{t+1}\alpha k_{2t}^{\alpha-1}l_{2t+1}^{1-\alpha}] + E_t[\beta_2(1-\tau_{kt+1})c_{2t+1}^{-\sigma}] \tag{1.13}$$

$$(1-\alpha)A_t k_{2t-1}^{\alpha} l_{2t}^{-\alpha}(1-\tau_{yt})c_{2t}^{-\sigma} = \chi l_{2t}^{n-1} \tag{1.14}$$

For a given set of tax rates, the model thus includes 14 variables: [c_{1t},c_{2t},k_{1t},k_{2t},l_{1t},l_{2t}, Y_{1t}, Y_{2t},b_t, A_t, G_t, T_{1t},T_{2t}, λ_t]. These corresponds to 6 first order conditions, 2 budget constraints, 2 production functions, the AR(1) process, and the credit constraint. Closing the model requires rules for fiscal policy. For our baseline case, we assume that all tax revenue is used to finance the public good. Transfers thus equal zero:[12]

$$G_t = \tau_{kt}(k_{1t-1} + k_{2t-1}) + \tau_y A_t(k_{1t-1}^{\alpha} l_{1t}^{1-\alpha} + k_{2t-1}^{\alpha} l_{2t}^{1-\alpha}) \tag{1.15}$$

We begin by analyzing the model's steady state for different tax rates. When examining the steady state, it makes no difference how these tax rates are determined. In section 3, we examine the dynamics of different tax rules.

2 Steady State Analysis

2.1 Baseline Results

We begin with our baseline case where the tax rate is flat, the aggregate capital stock is endogenous, and where all tax revenue is used to finance the public good. Later, we allow for progressive taxation, exogenous capital and for tax revenue to be used to finance transfers. In all cases, the wealth tax performs abysmally compared to the income tax when $\gamma \leq 1$.

The focus of this section is to analyze the steady state properties of two alternate tax regimes.

1. We refer to the first tax as a wealth tax where $\tau_b = \tau_k = \tau_y = \tau$. Here, households pay the same tax on all types of wealth: capital, bonds, and current income. We note that this is a tax on the market value of capital and bonds, not just on income derived from these assets.

2. The second is the common income tax where $\tau_y = \tau$ and $\tau_b = \tau_k = 0$.

We consider several other types of tax as well. We consider a wealth tax that excludes current income ($\tau_b = \tau_k = \tau$ and $\tau_y = 0$). Because a small (say 1%) tax on capital or bond wealth has large

[12] Section 2 allows for transfers and finds that while higher tax rates may be optimal, the wealth tax continues to perform poorly compared to the income tax.

effects on the model while an equal sized tax on income does not, the results are similar to #1. We thus do not report these results separately. We also consider a tax on capital only. These results are similar to #2 and we thus also spend little time reporting them separately. A tax on just bond wealth does produce significantly different results. But because net bond wealth is always zero, such a tax generates no revenue and both agents' utilities go to negative infinity for $\omega > 0$.[13]

We report results for a range of tax rates. For other parameters, we set $\alpha = 1/3$, a common value in the literature, and $\gamma = 0.85$, its value from Iacoviello (2005).[14] There is significant uncertainty about the best calibration of σ, χ, and η. We set $\sigma = 1$, $\chi = 1$, and $\eta = 2$. These are in the range found in the literature and our main results are robust to other reasonable calibrations.[15]

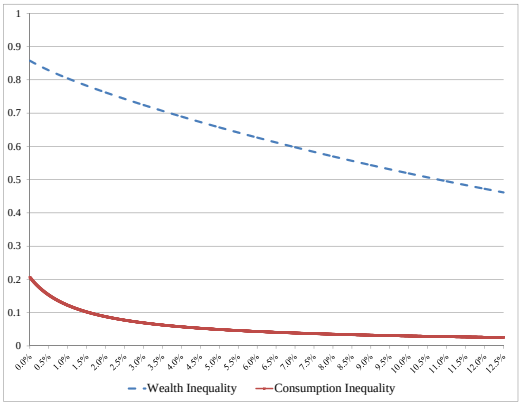
Because the main motivation for a wealth tax appears to be various types of inequality, we begin by examining the effects of different tax rates on inequality. We use a simple measure where:

$$INEQ_X = \frac{X_2 - \bar{X}}{\bar{X}} \tag{2.1}$$

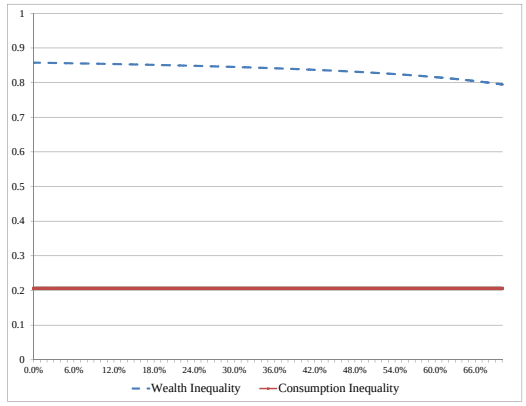
where $\bar{X} = mean(X_1, X_2)$. Our definition of inequality for X is the percentage deviation of patient households' value from the average. As patient households acquire all of a variable, this measure approaches 1. Total equality implies a value of 0, and a value of -1 implies that impatient households possess all of the variable.[16] Figure 1 reports the results for wealth and consumption inequality.[17]

Figure 1: Inequality for Different Tax Rates

Wealth Tax



Income Tax



The model tends toward substantial wealth inequality. With no taxes, $INEQ_W = 0.857$. Raising

[13] A tax on only bond wealth increases consumption inequality while causing a small decrease in wealth inequality. It also causes small declines to both types of households' consumption.

[14] Subsection 2.4 examines the effects of alternate values of γ. The only case we find where a wealth tax is preferable to an income tax is for $\gamma > 1.1$.

[15] See Shea (2013) for more discussion on the calibration of these parameters.

[16] This measure is a linear transformation, twice as steep, as the share of variable X owned by patient households.

[17] The measure of inequality is the same for gross wealth and after-tax wealth.

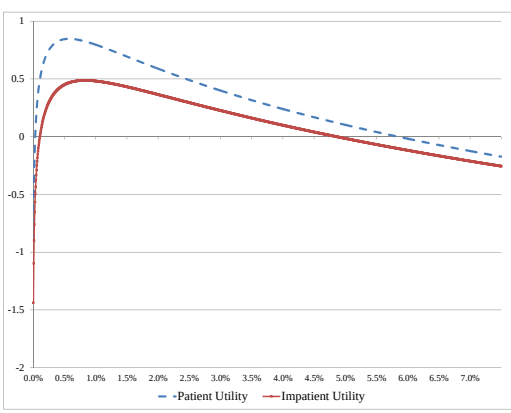
the wealth tax does reduce wealth inequality, lowering this value to 0.462 for $\tau = 12.5\%$. The wealth tax is a blunt instrument for reducing wealth inequality. While it does reduce patient households' capital stock and bond wealth, it also reduces impatient households' capital as well. As a result, even a very high tax rate still results in considerable inequality.

The wealth tax does better at eliminating consumption inequality. Patient households are more prone to saving and are thus harder hit by the tax. For $\tau = 0$, $INEQ_C = 0.207$. As the wealth tax increases, inequality appears to converge to zero and at $\tau = 12.5\%$, $INEQ_C = 0.025$. Figure 1 also reports the results for the income tax. The income tax does reduce wealth inequality, but by less than the wealth tax. Consumption inequality is hardly affected by the income tax.[18]

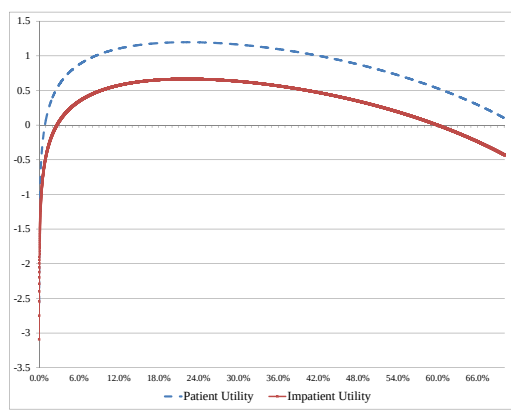
Figure 1 offers a superficial case in favor of a wealth tax. It is difficult to argue that policy makers should inherently care about inequality rather than a social welfare function that depends on each type of households' utility. Figure 2 displays the impact on household utility. Here, we set $\omega = 0.5$ and $\psi = 1$ implying that household value the public good half as much as private consumption. The literature provides little guidance on the appropriate value of ω and later in this section we vary ω from zero to one and discuss the implications.

Figure 2: Utility for Different Tax Rates

Wealth Tax



Income Tax



Close comparison of Figure 2 shows that patient households are better off with a wealth tax up to 2.47% than an income tax of the same amount. Impatient households are better off until the tax rate equals 3.66%. This is because wealth far exceeds income and the wealth tax is thus a more effective instrument of generating revenue than the income tax. Because the marginal benefit of government expenditures is high for low tax rates, such a wealth tax is prefarable. This result is not a case for a wealth tax. Later, we allow policy makers to optimally choose the tax rate. We find that they can

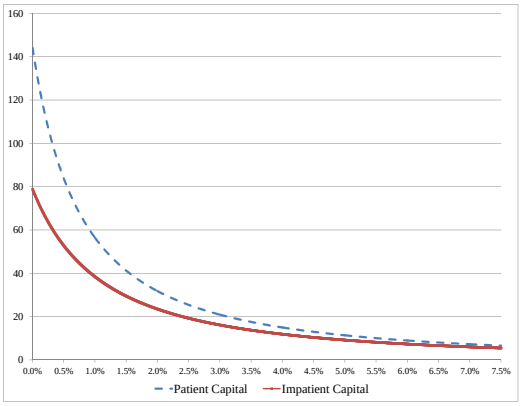
[18]Davies and Hoy (2002) find that inequality increases with the tax rate under a flat tax. Aronson, Johnson, and Lambert (1994) show that progressive income tax structures, however, promote equality.

always do better by choosing an income tax with a much higher rate than a wealth tax a long as $\gamma \leq 1$.

Figure 3 shows how each type of tax impacts capital. Unsurprisingly, the wealth tax results in a major reduction of both types of households' capital. The income tax, however, has mixed effects. Patient households increase their capital while impatient households decrease theirs. This result helps explain why the income tax is less effective at promoting equality.

Figure 3: Capital for Different Tax Rates

Wealth Tax



Income Tax

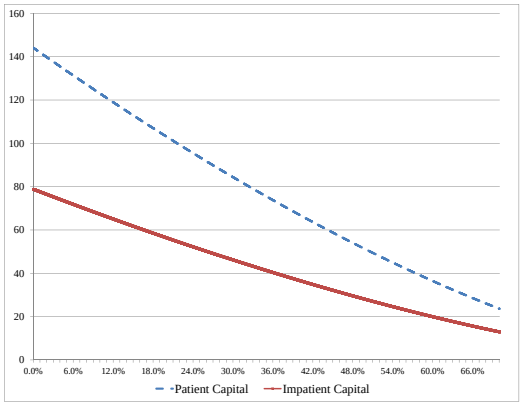
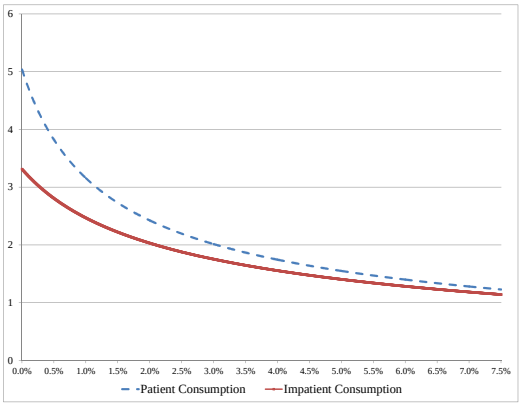


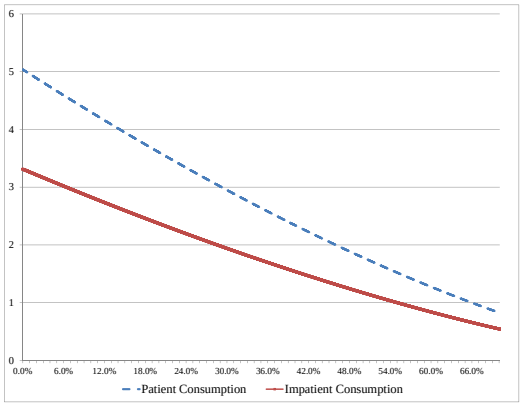
Figure 4 shows the effects of each tax on consumption. Unsurprisingly, higher taxes of either type reduce both patient and impatient household consumption.

Figure 4: Consumption for Different Tax Rates

Wealth Tax



Income Tax

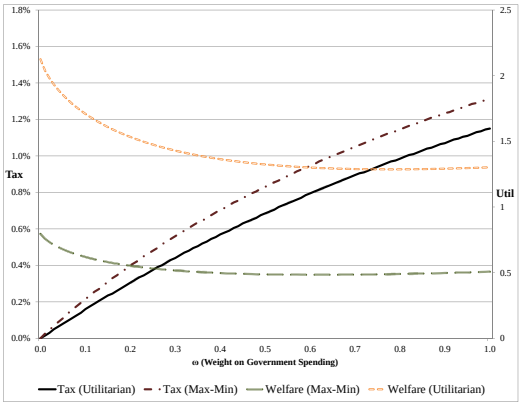


To tackle the issue of which type of tax is better, we analyze the model where policy makers optimize a social welfare function at the steady state for each type of tax. Because we have no idea what ω should equal, we allow this term to vary between 0 to 1. We consider two social welfare functions. The utilitarian function simply sums patient and impatient utility. The Max-Min function

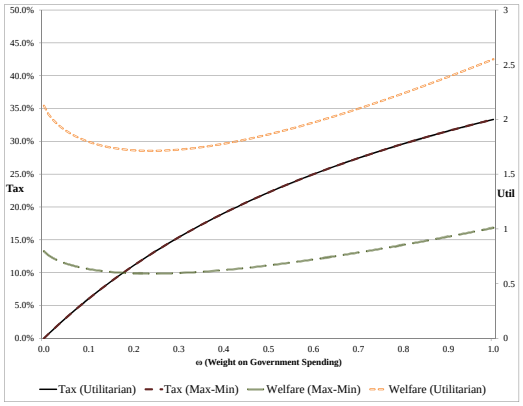
simply takes the minimum (usually impatient household utility) of each type of utility. Comparison thus offers a range between indifference to utility inequality (utilitarian) and a function where inequality is of great concern (Max-Min). Figure 5 describes the nature of the optimal wealth tax as the public good becomes more valuable.[19]

Figure 5: Optimal Tax Policy for Different Values of ω

Wealth Tax



Income Tax



When the public good provides no value ($\omega = 0$), the optimal wealth tax is zero. In this case, raising the wealth tax does increase equality of wealth and consumption.[20] It does so, however, only because it makes patient households worse off faster than it makes impatient households worse off. As $\omega \to 1$, the optimal wealth tax rate goes to 1.15% for the utilitarian social welfare function and 1.32% under the Max-Min social welfare function.

Because the income tax is narrower than the wealth tax, optimality requires higher tax rates. The optimal tax rate is identical for both social welfare functions and rises to 33% as $\omega \to 1$.

Figure 6 compares social welfare for different values of ω. The utility loss is converted to equal the decline in steady state consumption, for both household types under an income tax, needed to make social welfare equal to that under a wealth tax.

The performance of the wealth tax is ghastly. It is highly distortionary and inefficiently discourages capital formation. It also forces the policy maker to choose too little of the public good in order to minimize the former effect. As $\omega \to 1$, the welfare loss of choosing the optimal wealth tax instead of the optimal income tax is equivalent to about 40% of steady state consumption.

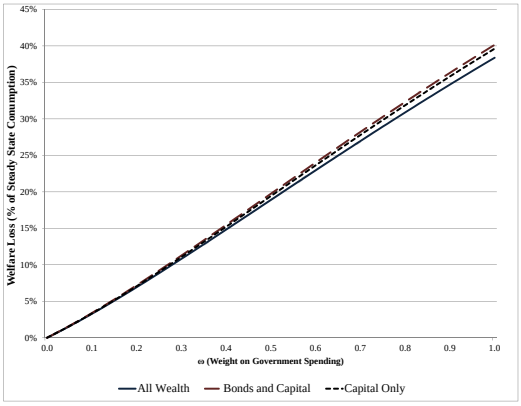
Figure 6 also shows that variations of the wealth tax perform similarly. A tax excluding current income (top line) performs worst, unsurprising given that this a more dramatic departure from the income tax. The best wealth tax is the baseline case (bottom line) where current income, capital

[19]Throughout the paper, optimality refers to the social welfare maximizing tax rate for a given type of tax. It does not, for example, imply that the optimal wealth tax is better than other type of taxes (*e.g* income, lump-sum).

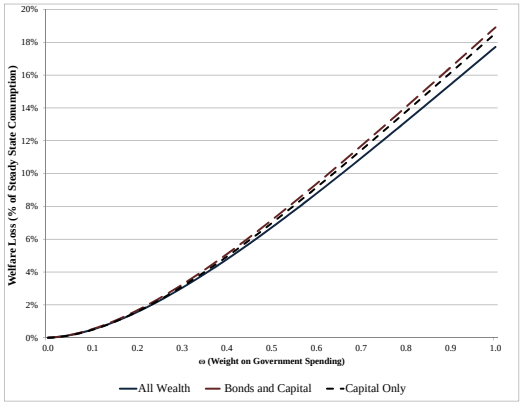
[20]Because households take the amount of the public good as given, ω does not affect any variables except utility.

Figure 6: Welfare Loss From A Wealth Tax

Utilitarian



Max-Min



wealth, and bond wealth are all taxed. Figure 6 also performs the same analysis for Max-Min social welfare. Now, the welfare loss is less, but still an enormous 18% as $\omega \to 1$.

These results show that while a wealth tax does reduce inequality, it does so primarily by making poorer (impatient households) worse off at a slower rate than it makes wealthier households worse off. A wealth tax is never optimal compared to an income tax and the welfare loss of using a wealth tax is surprisingly large. We now consider four extensions of the model: allowing progressive taxation, allowing transfer payments, varying the credit constraint, and fixing the capital stock. The only case where a wealth tax does better than an income tax is when we allow impatient households to go underwater on their debt.

2.2 Progressive Taxation

So far, our analysis has assumed a flat tax. In most economies, however, tax schedules are progressive. We thus compare the performance of wealth and income taxes where τ indicates the steady state tax rate paid by patient households and $\nu\tau$ is the tax rate paid by impatient households where $\nu \in (0, 1)$.[21] Throughout this exercise, impatient households are poorer than patient households when social welfare is maximized..

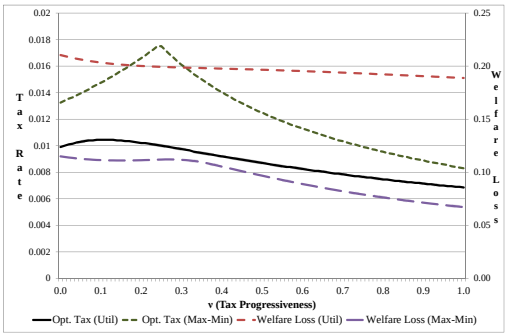
For each value of ν, we assume that the policy maker chooses the tax rate that maximizes social welfare within each type of tax. Figure 7 reports the results:

The most striking result is that the welfare loss of using a wealth tax is generally larger as taxation becomes more progressive. For $\omega = 0.5$ and $\nu = 1$, the welfare loss is 18.9% and 6.7% of steady state consumption under Utilitarian and Max-Min social welfare respectively. For $\nu = 0$, these values

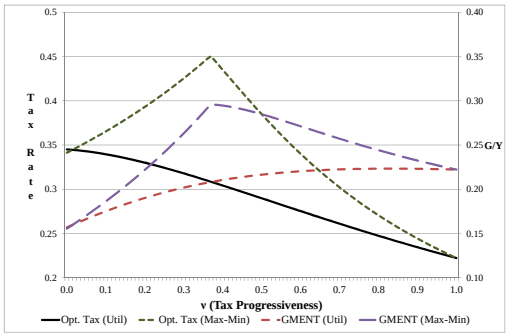
[21] We thus assume that the tax rate is based on households' fixed discount factor. Allowing the tax rate to instead depend on income or wealth would change their labor supply rules and is left for future research.

Figure 7: Results Under Progressive Taxation

Wealth Tax



Income Tax



rise to 21.0%, and 11.5%.

Under Max-Min social welfare, social welfare is observationally equivalent to impatient household utility for the tax rates from Figure 7. For lower values of ν, the policy maker generally chooses higher tax rates because poorer households are less affected by these taxes yet they benefit from the resulting government expenditures. For higher tax rates, however, the larger distortionary effect of the wealth tax are more pronounced resulting in a higher welfare loss as compared to the less distortionary income tax for low values of ν. These effects are smaller, but still present, under Utilitarian social welfare.

Unsurprisingly, progressive taxation results in higher tax rates for patient household and higher levels of government expenditures. For the wealth tax, social welfare is maximized for $\nu = 1$, and $\nu = 0.19$ for Utilitarian and Max-Min social welfare respectively. For the income tax, social welfare is maximized for $\nu = 0.68$, and $\nu = 0.20$ for Utilitarian and Max-Min social welfare respectively, If we assume the policy maker optimally chooses both τ and ν under each regime, then the welfare loss of using a wealth tax intead of an income tax is 19.2% and 11.1% of steady state conssumption under Utilitarian and Max-Min social welfare respectively.

2.3 Allowing Transfers

We now extend the model to allow the policy maker to use tax revenue to provide transfer payments. Transfer payments provide an additional incentive to tax and we do find that in the case of Max-Min social welfare, some taxation is optimal even when $\omega = 0$. We assume that the policy maker chooses between two fiscal policies. The first is the baseline case without transfers. The second is a level of transfers that equates the marginal benefit to social welfare of one additional transfer payment

and one additional unit of the public good. In the case of utilitarian social welfare, transfers then equal:

$$T_{1t} = \begin{cases} 0 & if \quad 2\omega G_t^{-\psi} > C_{1t}^{-\sigma} \\ TR_t - (\frac{C_t^{-\sigma}}{2\omega})^{\frac{-1}{\psi}} & if \quad 2\omega G_t^{-\psi} \leq C_{1t}^{-\sigma} \end{cases} \tag{2.2}$$

where $T_{2t} = 0$ and TR_t denotes tax revenue. The policy maker begins providing transfer payments to impatient households once the marginal benefit of their consumption is twice as large (because the public good provides utility to both types of agents) as the marginal benefit of providing the public good.[22]

Under Max-Min preferences, the policy maker is only concerned with impatient household utility on the margin. She thus begins providing transfer payments once the marginal utility of impatient consumption exceeds that of the marginal utility (to the impatient household only) of the public good.

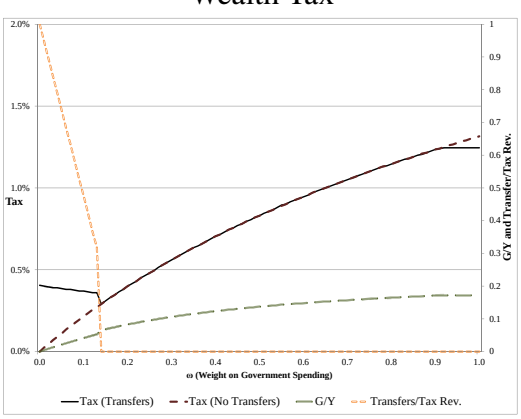
$$T_{1t} = \begin{cases} 0 & if \quad \omega G_t^{-\psi} > C_{1t}^{-\sigma} \\ TR_t - (\frac{C_t^{-\sigma}}{\omega})^{\frac{-1}{\psi}} & if \quad \omega G_t^{-\psi} \leq C_{1t}^{-\sigma} \end{cases} \tag{2.3}$$

Transfers increase the utility of impatient households while decreasing that of patient households. Because of taxation's distortionary effect, the sum of utility declines. Numerical calculations show that it is never optimal to make transfer payments under the Utilitarian social welfare function. Likewise, it is never optimal to do so for large enough values of ω. It is, however, optimal to make them under Max-Min social welfare when ω is low.

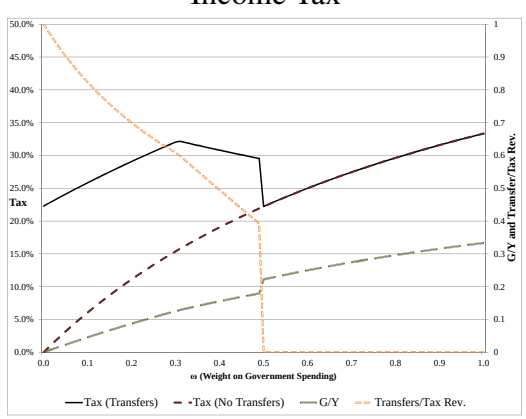
Figure 8 illustrates the optimal level of transfer under Max-Min social welfare:

Figure 8: Max-Min Social Welfare and Transfers

Wealth Tax



Income Tax



[22] More generally, the policy maker might consider making transfer payments to Agent 2. This, however, is never optimal under any scenario that we examine.

Unlike the baseline case, it is now optimal to impose a wealth tax (about 0.4%) even if $\omega = 0$. By $\omega = 0.15$, all tax revenue should go toward the public good. The ratio of government spending to output rises to almost 20% as $\omega \to 1$. Under an income tax, the policy maker chooses $\tau_y = 23\%$ when the public good is not valued. Transfers continue to be chosen until about $\omega = 0.5$. Notably, the share of government expenditures to output rises to over 30% as $\omega \to 1$.[23] Because an income tax is less distortionary than the wealth tax, the policy maker is able to optimally provide more of the public good.[24]

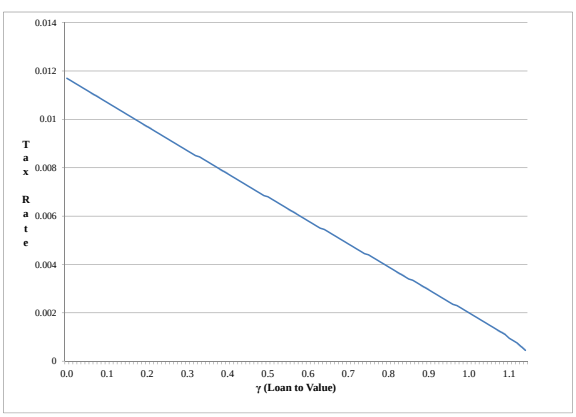
2.4 Isolating the Effects of the Credit Constraint

Two notable features of the Kiyotaki and Moore (1997) framework are different discount factors and the credit constraint. The former is sufficient to yield heterogeneity and this section therefore isolates each effect by varying γ, the ability of impatient households to borrow.

A wealth tax generally reduces the capital stock in two ways. First, it reduces the return to capital and thus discourages its production. This obvious effect exists even when $\gamma = 0$. Second, it makes a unit of capital less effective at increasing impatient households' access to credit. As γ increases, this effect becomes more important. Figure 9 illustrates the wealth tax needed to reduce k_1 by 25% from its tax free value.[25] As γ increases, the wealth tax much more readily discourages impatient households from acquiring capital.

Figure 9: Tax Needed to Reduce k_1 by 25%

Wealth Tax



Income Tax

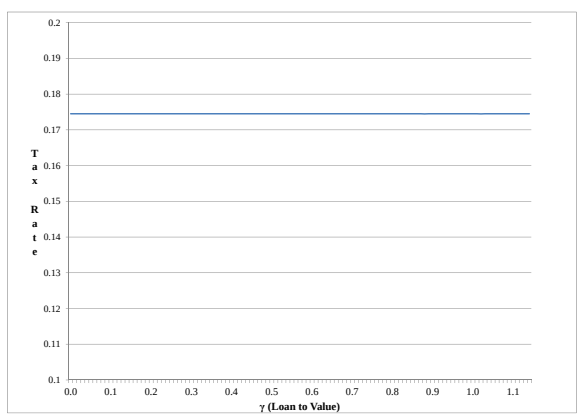


Figure 10 shows the optimal tax rates and associated welfare loss for different values of γ. For

[23] For most OECD countries, government expenditures range between 35% and 53% of GDP.

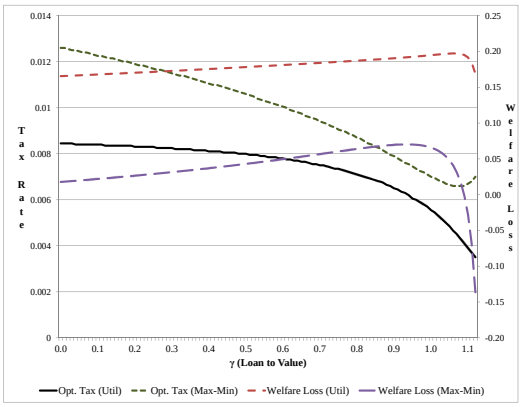
[24] In a related result, we find that the peak of the Laffer Curve for the income tax generates more than twice a much tax revenue than that of the wealth tax.

[25] Throughout this section, we set transfers equal to zero.

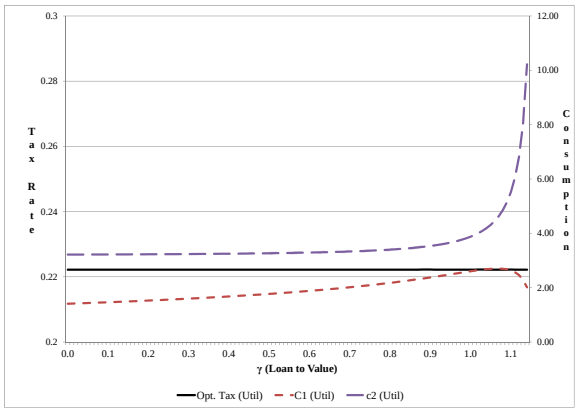
$\gamma \leq 1$, the distortionary effects of the wealth tax become worse and optimality requires a lower rate. Less of the public good is provided and the welfare loss (compared to an income tax), as measured as a share of steady state consumption, becomes larger.

Figure 10: Optimal Tax Rate for Different Values of γ

Wealth Tax



Income Tax



The optimal income tax is largely independent of γ. For $\gamma > 1$, however, impatient households become excessively leveraged and their consumption exhibits a dramatic decline.[26] The left panel of Figure 10 shows the welfare loss from using a wealth tax instead of an income tax. For large values of γ, a wealth tax prevents impatient households from becoming extremely leveraged by inhibiting impatient households from acquiring enough collateral (k_1) to become so indebted. Very high values of γ are thus the only version of the model that we examine where the wealth tax outperforms the income tax. Under Max-Min social welfare, the wealth tax is preferable for $\gamma \geq 1.09$ and it is preferable for $\gamma \geq 1.14$ for Utilitarian social welfare.

Values of γ greater than one are inconsistent with Kiyotaki and Moore's (1997) interpretation of $1 - \gamma$ as the cost of repossessing collateral. More generally, however, such calibrations allow impatient households to go underwater on their debt. While we do not formally include factors, such as reputation, in our model that would yield such behavior, there is empirical evidence that borrowers will often continue to make debt payments even when their debt exceeds their assets. Fuster and Willen (2013), for example, find that strategic mortgage default generally occurs when loan to value ratios range between 100% and 150%.

[26] Marshall (2014) finds that γ has large steady state effects. She finds in a model of housing that more access to credit for households increases output while more access for producers reduces output. Here, steady state output rises because greater access to credit incentivizes additional capital formation.

2.5 Fixed Capital

We have found that the wealth tax usually performs terribly. This is partly because, by taxing capital, it discourages its formation. We might thus expect that a wealth tax would do better if capital is fixed. Surprisingly, we find that it does even worse.

We now fix the aggregate capital stock at 222.95, its value without taxation for the endogenous capital case. The representative impatient household's optimization problem then becomes:[27]

$$Max_{c_{1t},b_{1t},l_{1t}} \quad E_t\left[\sum_{i=0}^{\infty}\beta_1^i\left(\frac{c_{1t+i}^{1-\sigma}}{1-\sigma}+\omega\frac{G_{t+i}^{1-\psi}}{1-\psi}-\chi\frac{l_{1t+i}^{\eta}}{\eta}\right)\right] \tag{2.4}$$

s.t

$$c_{1t}+q_t(k_{1t}-(1-\tau_{kt})k_{1t-1})=(1-\tau_{yt})A_tk_{1t-1}^{\alpha}l_{1t}^{1-\alpha}+b_t-R_{t-1}(1-\tau_{bt})b_{t-1}+T_{1t} \tag{2.5}$$

$$R_tb_t\leq\gamma E_t[q_{t+1}(1-\tau_{kt+1})k_{1t}] \tag{2.6}$$

and (1.3). The variable q_t denotes the price of capital which is no longer always equal to 1.

Optimization then yields:

$$c_{1t}^{-\sigma}=E_t[\frac{\beta_1(1-\tau_{yt+1})c_{1t+1}^{-\sigma}A_{t+1}\alpha k_{1t}^{\alpha-1}l_{1t+1}^{1-\alpha}}{q_t}]+E_t[\frac{q_{t+1}}{q_t}\beta_1(1-\tau_{kt+1})c_{1t+1}^{-\sigma}]+E_t[\frac{q_{t+1}}{q_t}\gamma(1-\tau_{kt+1})\lambda_t] \tag{2.7}$$

and (1.6) and (1.8).

We examine the case without transfers. For the wealth tax, as τ increases, impatient households acquire almost all of the economy's capital stock. Their debt payments and labor supply increase while their utility and consumption decline. Patient households come to live almost exclusively on debt payments and see relatively stable consumption and utility.

Figure 11 illustrates these effects on capital and consumption.

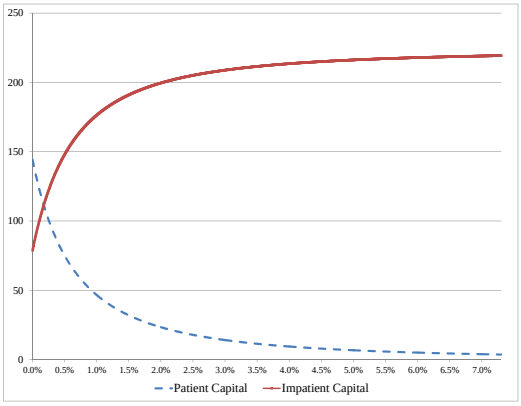
Because these effects are so detrimental to impatient household utility, optimality requires much lower levels of taxation than for the model with endogenous capital. Even with Max-Min preferences, the optimal wealth tax is never much greater than 0.2%. Figure 12 shows the optimal wealth tax and welfare loss from using a wealth tax instead of an income tax.

With fixed capital, the income tax has weaker, but qualitatively similar effects as the wealth tax.

[27]The representative patient household's problem changes in a similar manner and is not shown here.

Figure 11: Effects of a Wealth Tax, Exogenous Capital

Capital



Consumption

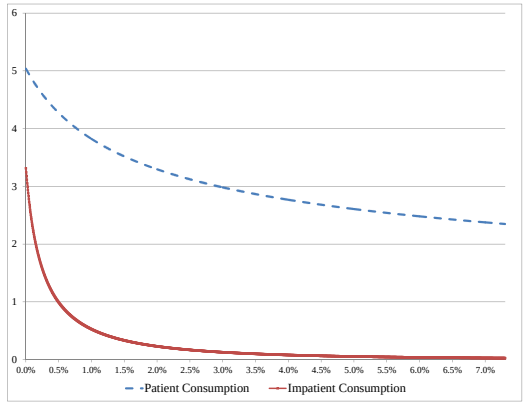
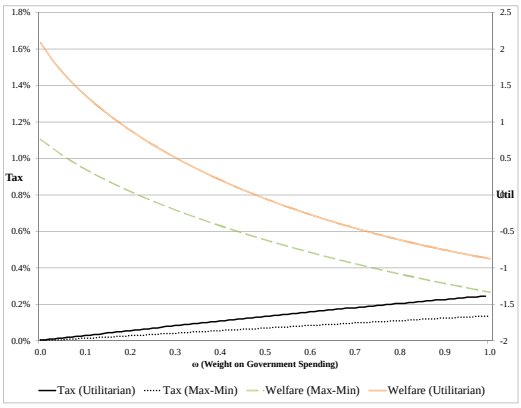
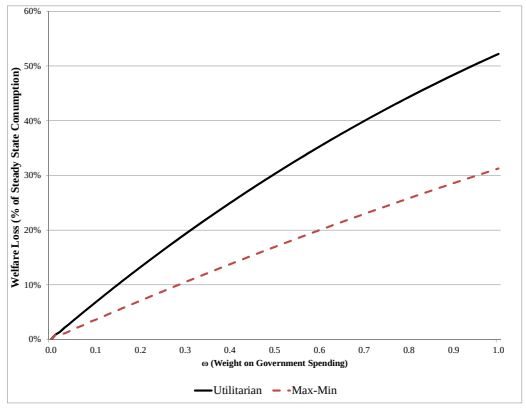


Figure 12: Performance of Wealth Tax, Exogenous Capital

Optimal Tax Rate



Welfare Loss



Because the wealth tax drives impatient consumption towards zero faster than the income tax, it does even worse with fixed capital. For utilitarian social welfare, this loss exceeds 50% of steady state consumption as $\omega \to 1$.

3 Business Cycle Dynamics

The magnitude of the effects shown in Section 2 likely ensures that optimality requires choosing the tax regime that maximizes steady state social welfare. This section extends the analysis to examine the dynamics of the business cycle around each steady state. We begin by comparing each tax regime where the tax rate follows an AR(1) process. The wealth tax is described by:

$$\tau_{yt} = \tau_{yt} = \tau_{yt} = \tau_t = \tau_{t-1}^{\rho_\tau} u_t \tag{3.1}$$

where $log(u_t)$ is white noise with mean equal to $\bar{\tau}^{1-\rho_\tau}$. The income tax regime is described by:

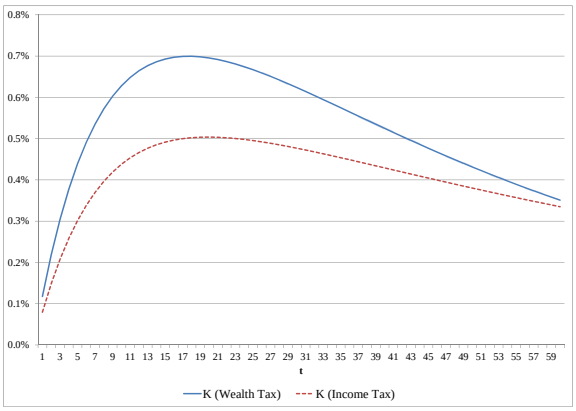
$$\tau_y = \tau_t = \tau_{t-1}^{\rho_\tau} u_t \tag{3.2}$$

where $\tau_k = \tau_b = 0$. We compare the two regimes around the steady state tax rates that maximize steady state social welfare for $\omega = 0.5$: 0.65% for the wealth tax and 26.7% for the income tax. We set $\rho = \rho_\tau = 0.9$ and use the calibration from Section 2 for the remaining parameters.

We begin by considering a one-time innovation to productivity by setting $e_t = 0.02$ from (1.5). Figure 13 shows the IRFs for k_t and y_t while Figure 14 shows them for each households' consumption. Throughout this section, IRFs are measured as percentage deviations from the steady state.

Figure 13: Response of Capital and Output to a Productivity Shock

Capital



Output

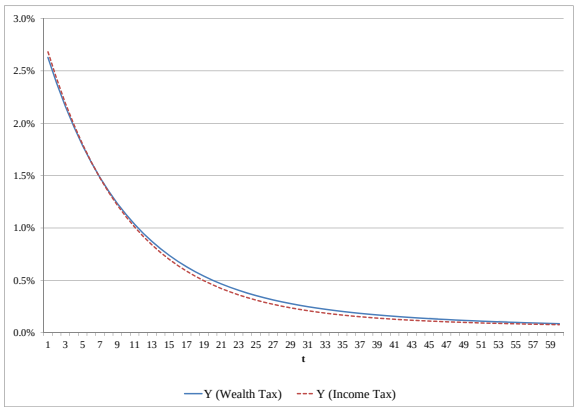
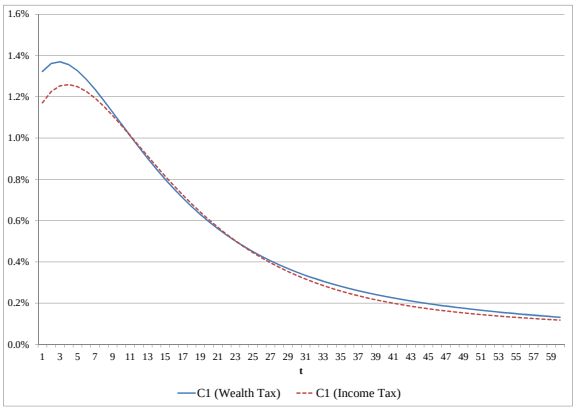
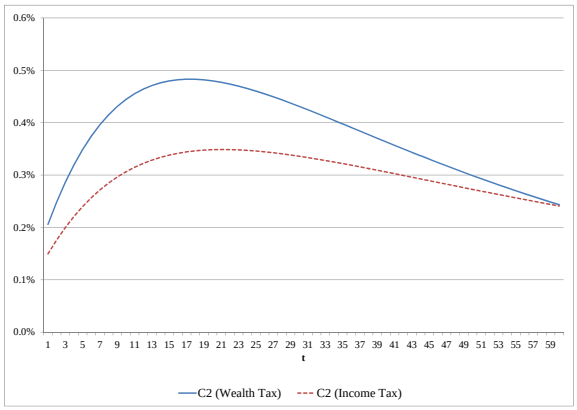


Figure 14: Response of Consumption to a Productivity Shock

Impatient Consumption



Patient Consumption



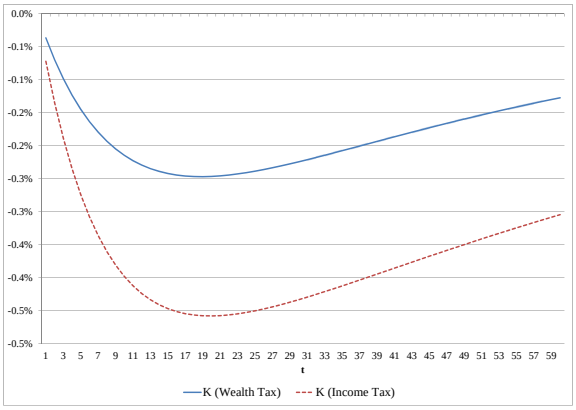
The response to a productivity shock is similar for each tax regime. As expected, capital, consumption, and output each increase. Notably, however, the wealth tax reduces the incentive for house-

holds to spread the benefits of the shock out by increasing their capital stock. As a result, the peak effects (excluding on output) for the wealth tax are larger under the wealth tax, but the effects of the shock last longer under the income tax.

We now examine the IRFs for an innovation to the tax rate equal to 5% of the steady state tax rate. Figures 15 and 16 report the results:

Figure 15: Response of Capital and Output to a Tax Shock

Capital



Output

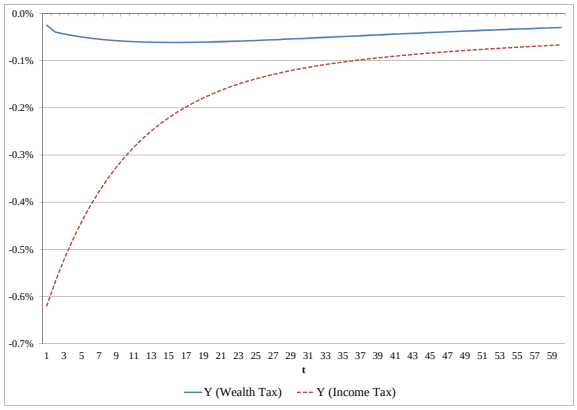
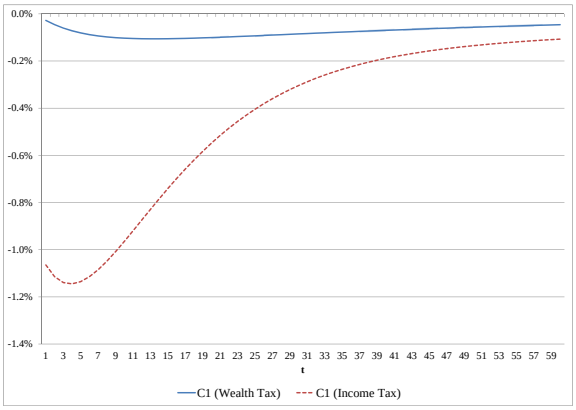
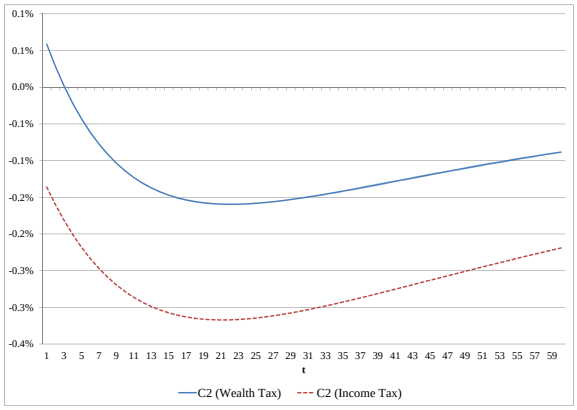


Figure 16: Response of Consumption to a Tax Shock

Impatient Consumption



Patient Consumption



The peak effects have the expected signs. Capital, consumption, and output all decline in response to higher taxes. Notably, the effects are much smaller under the capital tax than the income tax.[28] The wealth tax generates most of its revenue by taxing capital. Households, however, are slow to adjust their capital stocks which causes only modest declines by the time the tax shock has largely worn off.

[28] Because the IRFs report percentage deviations and the wealth tax yields lower steady state values, the absolute changes are even smaller under the wealth tax compared to the income tax than shown in the IRFs.

Table 1: Simulated Standard Deviations (% Deviations From Steady State)

	Wealth Tax	Income Tax
c_{1t}	0.91%	1.98%
c_{2t}	0.69%	1.11%
k_{1t}	1.17%	2.21%
k_{2t}	0.98%	1.45%
l_{1t}	0.15%	0.44%
l_{2t}	0.47%	1.13%
y_{1t}	1.10%	1.33%
y_{2t}	1.12%	1.30%
b_t	1.18%	2.20%
G_t	4.45%	4.10%

In contrast, because labor supply can adjust rapidly, higher income taxes cause much larger initial decreases to output.

We now calculate the simulated second moments setting the standard deviation of tax shocks equal to 0.88% of the steady state tax rate, and shocks to productivity equal to 0.15%. All standard deviations are reported as percentage deviation from the steady state.

Table 1 suggests that the wealth tax offers greater stability (excepting government expenditures) around an undesirable steady state whereas the income tax yields greater volatility, but around a far superior steady state.[29]

3.1 Indeterminacy

A vast literature examines conditions under which a macroeconomic model yields a unique equilibrium. Cases where a model's equilibrium is indeterminate are of special concern because these solutions may depend on extraneous expectational errors that increase volatility. As a result, indeterminacy is typically viewed as an unfavorable outcome. This model, with the exogenous rates from (3.1) and (3.2) always results in determinacy.[30] Schmitt-Grohe and Uribe (1997), however, show that in a RBC model without credit constraints, indeterminacy arises over much of the parameter space when government expenditures are exogenous and tax rates endogenously adjust to balance the bud-

[29]The simulated volatilities are similar for both tax regimes when there are productivity shocks but no tax shocks. As tax shocks then become larger, the wealth tax induces increasingly more stability than the income tax.

[30]Determinacy is easily analyzed using the well known method of Blanchard and Kahn (1980). The model contains 7 expectational terms: two consumption terms, three tax terms, and two labor supply terms. The model is linearized and the number of explosive roots is compared with the number of expectational terms. If the number of explosive roots equals the number of expectational terms, then equilibrium is determinate. If there are fewer explosive roots, equilibrium is indeterminate. If there are more explosive roots, then no stationary equilibrium exists.

get.[31] It seems plausible that this source of indeterminacy might exist in this model as well. This section analyzes the potential for indeterminacy, for both tax regimes, under different fiscal rules that a policy maker might reasonably consider.

To evaluate indeterminacy, we vary γ between 0 and 1, and η between 1 and 5, while holding most other parameters constant at their values from Section 2. We vary these parameters because the calibration of neither is well established, and because many existing sources of indeterminacy are known to be sensitive to the latter. We vary $\bar{\tau}$ from 0 to 1. We set transfers equal to zero and the calibration of ω is thus irrelevant to the analysis. We evaluate determinacy for both tax regimes.[32]

Rule 1. Exogenous Tax Rates.

This is the rule described by (3.1) and (3.2). Here, the tax rate is exogenous and government expenditures endogenously adjust. In Schmitt-Grohe and Uribe (1997), this type of tax rule does not generate indeterminacy. Likewise, in our model, this rule always results in determinacy for both tax regimes. This result is unsurprising. When the tax rate is exogenous, its rational expectation is also pinned down and there is no channel for expectations to become self-fulfilling.

Rule 2. Schmitt-Grohe and Uribe (1997) - Balanced Budget Rule.

Here, the policy maker is assumed to balance the budget each period by adjusting the tax rate to equal the exogenous level of government expenditures. Formally, the tax rate evolves according to the following rules for the wealth tax and income tax respectively:

$$\tau_{yt}(y_{1t} + y_{2t}) + \tau_{kt}(k_{1t-1} + k_{2t-1}) = G_t \tag{3.3}$$

$$\tau_{yt}(y_{1t} + y_{2t}) = G_t \tag{3.4}$$

where G_t is some exogenous process, the exact nature of which does not affect the determinacy analysis. We find the following:

i. The wealth tax always yields determinacy.

[31] Other common sources of indeterminacy in the RBC literature include assuming increasing returns to scale (see Farmer and Guo (1994)), and learning by doing combined with heterogeneous discount factors (See Shea (2013)). Indeterminacy is a major concern in the New Keynesian literature where it often arises if monetary policy does not aggressively enough raise interest rates in response to inflation (See Woodford (2003)).

[32] Variations of the wealth tax, such as excluding current income or bond wealth, yield similar results.

ii. The income tax does yield a region of indeterminacy. This region occurs: a) where the average level of government expenditures is high (at least 1.6, corresponding to a tax rate of at least 36.45%) but less than 67%, b) where $\eta = 1$.[33] These results are consistent with Schmitt-Grohe and Uribe (1997) who also required highly elastic labor supply and sufficiently high steady state tax rates.

These results illustrate an advantage of a wealth tax over an income tax because only the latter yields this type of indeterminacy. Under rational expectations, indeterminacy may add volatility by allowing sunspots - extraneous expectational errors - to affect the model. Due to the magnitude of the results from Section 2, indeterminacy will surely not cause a wealth tax to be optimal for any plausible distribution of sunspot shocks under rational expectations. Indeterminacy does, however, offer an additional complication. We can examine the model under the assumption that agents form expectations through adaptive learning instead of rational expectations. Under adaptive learning, agents use econometric algorithms, most often least squares, to form forecasts instead of using the model's reduced form solution as they do under rational expectations.[34] Evans and McGough (2005) show that when indeterminacy arises due to stable, positive roots, as it does both in this model, and in Schmitt-Grohe and Uribe (1997), then the corresponding solutions are not stable under learning. If agents attempt to learn the model's solution, it will not converge to the rational expectations solution, but will instead either diverge or converge to something else. The model thus contains substantially more volatility than exhibited under rational expectations.

Rule 3. Targeting Current Inequality.

Because the main motivation for a wealth tax appears to be inequality, it is reasonable to imagine that such a tax might automatically adjust to some measure of inequality. We thus consider rules of the following form for the wealth tax and income tax respectively:

$$\tau_{yt} = \tau_{yt} = \tau_{yt} = \tau_t = \bar{\tau} + \phi I\tilde{NEQ}_{X_t} \tag{3.5}$$

$$\tau_{yt} = \bar{\tau} + \phi I\tilde{NEQ}_{X_t} \tag{3.6}$$

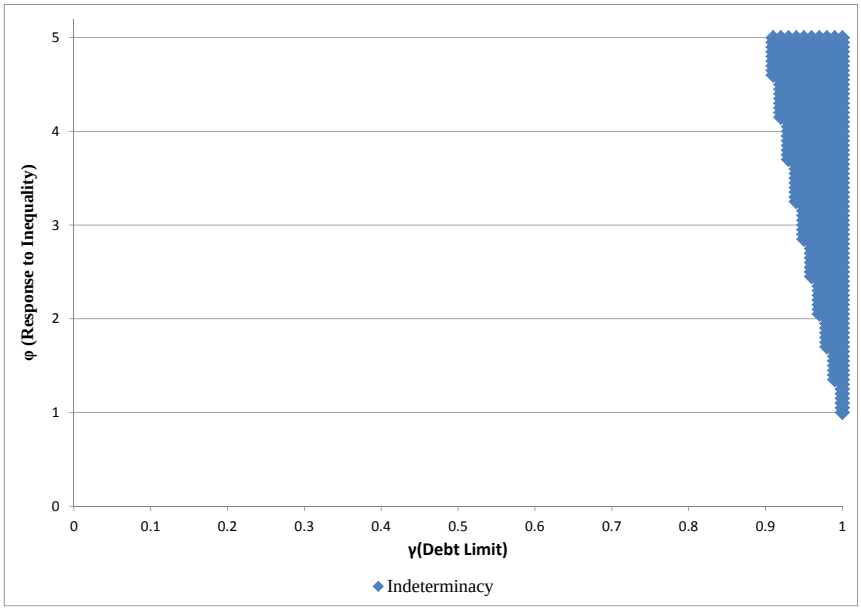
where inequality (measured as a percentage deviation from its steady state value) might refer to consumption, wealth, or income inequality. For the wealth tax, we find the following:

[33] We examined determinacy at $\eta = 1, 1.5, 2...6$. Indeterminacy never occurs for $\eta \geq 1.5$.

[34] The main argument in favor of adaptive learning is that its informational requirements are more realistic than rational expectations. See Evans and Honkapohja (2001) both for additional details on the mechanics of adaptive learning and discussion of its merits as a modeling approach.

i. If the wealth tax responds to inequality of wealth, then a region of indeterminacy corresponding to high values of ϕ and γ exists. For example, under our baseline calibration, γ must be close to one and ϕ must be at least 1.5. Furthermore, there is a region where no stable equilibrium exists corresponding to high value of ϕ and intermediate values of γ. Figure 17 shows the region of indeterminacy for $\bar{\tau} = 0.65\%$, and $\eta = 2$:

Figure 17: Region of Indeterminacy, Wealth Tax that Responds to Current Wealth Inequality



ii. If the wealth tax responds to consumption inequality, then indeterminacy never occurs. There is, however, a region where there is no stable equilibrium for high values of γ and ϕ, and low values of η.

iii. If the wealth tax responds to income inequality, then the results are similar to i.

For the income tax, we find the following:

iv. If the income tax responds to inequality of wealth, then indeterminacy never occurs. There is a small region where no stationary equilibrium exists for $\bar{\tau}$ at least 0.32 and ϕ at least 4.5.

v. If the income tax responds to consumption inequality, then there is a large area where no stationary equilibrium exists for sufficiently large ϕ. This occurs because the income tax has very little effect on consumption inequality.

vi. If the income tax responds to income inequality, then the solution is always determinate.

These results illustrate a new source of indeterminacy that is an additional hazard for policymakers to navigate under a wealth tax. Suppose, for example, that agents extraneously expect the wealth tax to increase in the next period. This has the effect of discouraging capital accumulation. Indeterminacy occurs if such an expectation is self-fulfilling. When γ is low, patient households own most of the capital stock and are most affected by a higher tax. The expectation of a higher tax thus reduces inequality and thus induces policy makers to lower the tax rate. The expectation is not self-fulfilling. For high values of γ, however, impatient households hold most of the capital. The expectation of higher taxes thus primarily affects them, increasing wealth inequality. If ϕ is large enough, policy makers then raise taxes causing the extraneous expectation to be self-fulfilling.

Rule 4. Targeting Future Inequality.

We also consider rules where the tax rate responds to future inequality:

$$\tau_{yt} = \tau_{kt} = \tau_{bt} = \tau_t = \bar{\tau} + \phi E_t[I\tilde{N}EQ_{X_{t+1}}] \tag{3.7}$$

$$\tau_{yt} = \bar{\tau} + \phi E_t[I\tilde{N}EQ_{X_{t+1}}] \tag{3.8}$$

For the wealth tax, we find the following:

i. If the wealth tax responds to inequality of wealth, indeterminacy occurs for high values of ϕ (≥ 3) and high values of γ (≥ 0.9).

ii. If the wealth tax responds to consumption inequality, indeterminacy occurs for high values of γ (≥ 0.9).

iii. If the wealth tax responds to income inequality, indeterminacy occurs for moderate or higher values of γ (≥ 0.4). There is no stationary equilibrium for low values of γ (≤ 0.3).

For the income tax, we find the following:

iv. If the income tax responds to inequality of wealth, indeterminacy never occurs. There is no stationary equilibrium when the value of ϕ is high (≥ 4.5) and the value of γ is low (≤ 0.3).

v. If the income tax responds to consumption inequality, indeterminacy never occurs. However, there is often no stationary equilibrium, especially when $\phi \geq 2.5$.

vi. If the income tax responds to income inequality, indeterminacy often occurs when the value of γ is high (≥ 0.9).

For these forward looking tax rules, the stability of the system is sensitive to γ. High values often are destabilizing by allowing for indeterminacy. Low values are often destabilizing by preventing the existence of a stationary equilibrium. Intermediate value are thus most likely to induce determinacy.

Rule 5. Targeting Past Inequality.

Finally, we conider rules that respond to lagged measures of inequality:

$$\tau_{yt} = \tau_{yt} = \tau_{yt} = \tau_t = \bar{\tau} + \phi I\tilde{NEQ}_{X_{t-1}} \tag{3.9}$$

$$\tau_{yt} = \bar{\tau} + \phi I\tilde{NEQ}_{X_{t-1}} \tag{3.10}$$

Backwards looking rules generally result in less indeterminacy than other rules. Neither tax regimes exhibits any indeterminacy under these rules. There are, however, regions where no stationary equilibrium exists. These typically occur for large values of ϕ, beginning around 2.5-4.5, depending on the exact rule.

4 Conclusion

Rising economic inequality has generated interest in a wealth tax as a way of promoting greater equality. This paper examines the relationship among tax regimes, inequality, and welfare in a popular macroeconomic framework. We find that a wealth tax does result in much more equality than an income tax. Our results, however, generally find that an income tax is preferable despite causing more inequality and volatility. A wealth tax often results in substantially worse steady state performance than an income tax, even when the social welfare function is Max-Min and is thus concerned only with the welfare of the poorer households on the margins. The only case we find where the wealth tax is preferable is when impatient households are allowed to go significantly underwater on their debt. Here, the wealth tax prevents excessive leveraging that dramatically reduce their steady state consumption.

This paper's results are largely consistent with the revealed preferences of policy makers who rely mostly, but not exclusively, on income taxes instead of wealth taxes. There are of course, a myriad of macroeconomic modeling approaches and it is, of course, possible that alternate approaches could yield mechanisms that improve the wealth tax' performance. The case for a wealth tax would be bolstered if plausible and robust assumptions where it is desirable could be identified. The set of assumptions examined in this paper, however, strongly suggest that current fiscal policy is right to largely reject a comprehensive wealth tax.

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