Tax Morale with Partisan Parties*

Abstract

This paper analyzes the political economy of income redistribution when voters are concerned about tax compliance. We consider a two stage-model where there is a two party competition over the tax rate in the first stage and voters decide about their level of tax compliance in the second stage. We model political competition *à la* Wittman with the ideology of parties endogenously determined at equilibrium. We calibrate the model for an average of EU-27 countries. Numerical simulations provide the tax rates proposed by the two parties and the level of tax compliance. We find that a decrease in the perceived average level of tax compliance, increase the probability that the party offering the lowest income tax will win. Moreover, the same result is obtained when parties' uncertainty about the preferences of the median voter increases.

Keywords tax evasion, ideological parties, income redistribution, ethical voters.

JEL Classification D72, H26

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1 Introduction

In the context of the recent debt crisis, tax compliance has been a hot issue in many parliaments of developed countries. For instance, Mitt Romney's case of tax avoidance introduced another dimension into the debate about income taxes in the 2012 US Elections. The importance of tax compliance in politics is even greater in European countries with financing problems such as Greece, Portugal, Ireland, Spain and Italy. While millions of citizens are asked by their governments to bear heavy tax hikes, recent news report important cases of tax evasion, tax avoidance and tax fraud by politicians and large fortunes in these countries (see the case of the Barcenas scandal[1], Lagarde's list or the Spanish tax amnesty for some examples). This misbehavior affects public opinion on society's tax morale which may result in voters' shifting their preferences for income redistribution.

The aim of this paper is to study political behavior when the salient electoral issue is income tax, voters have concerns about tax compliance, and political parties are formed endogenously. We propose a two-stage model in which parties compete over the level of income redistribution (through a flat income tax and social transfer) in the first stage, and voters decide about their level of tax compliance in the second stage. We find that as voters become more confident about society's tax morale, there is an increase in both the probability that the party more in favor of income redistribution will win and the level of tax compliance.

There is a vast literature on tax compliance (see Andreoni,1998; Slemrod and Yitzhaki, 2002; Slemrod, 2007 for excellent surveys). Most of the studies in the literature are based on the framework proposed by Allingham and Sandmo (1972) in which tax payers maximize their expected utility under the probability of a penalty if they are caught underreporting their taxable income. This deterrence theory has been criticized by many authors because it predicts a much lower compliance rate than what we actually observe (see Graetz and Wilde, 1985; Alm et al., 1992; Frey and Feld, 2002).

Behavioral models that assume some tax morale in tax payers try to solve this empirical problem. For instance, Erard and Feinstein (1994) proposed a model in which tax noncompliance produces feelings of guilt and shame that

[1] A description of the facts can be found here: http://www.nytimes.com/2013/02/01/world/europe/prime-minister-of-spain-accused-of-receiving-payouts.html?_r=0

are incorporated exogenously in taxpayers' utility function. Gordon (1989) addressed the topic of fairness and tax compliance. He makes the psychic cost of tax evasion endogenous in a dynamic model in which this psychic cost varies inversely with the number of individuals evading in the previous period. Other papers have focused on the effect of corruption and waste of resources by the government on tax compliance. Pommerehne, Albert Hart, and Frey (1994) presented a dynamic model in which taxpayer compliance reduces with deviation between the individual's optimal choice of public good provision and the one implemented, noncompliance by other taxpayers, and the level of government waste in the previous period.

Following the approach of these behavioral models, we assume that individuals are ethical regarding tax avoidance. That is, they have direct negative preferences on the aggregated level of tax avoidance in society. Consequently, any increase in the aggregated level of tax avoidance directly reduces tax payers' welfare. Additionally, we assume that there is no mechanism of punishment to induce compliance. Therefore, tax morale is the only reason to comply. This is done for the sake of simplicity as incorporating punishment would complicate the analysis and not add any further insight to our study.

Empirically, Spicer and Becker (1980) supported the premise that fairness is important for tax compliance. They experimentally find that individuals' decisions about tax evasion depend on the relative comparison between their payments and others' payments. Theoretically, a similar approach is suggested in Bordignon(1993) who modeled taxpayers with Kantian preferences. That is, individuals' decisions about compliance depend on what they consider is fair, which in turn would depend on their conjectures about the aggregated level of tax compliance.

We incorporate this feature in our model assuming that voters behave according to Kant's morals, that is, any individual assumes that the other individuals will act as she does. More precisely, we assume that taxpayers make conjectures about the aggregated level of tax compliance, i.e. about society's tax morale, and these conjectures depend on their particular willingness to comply. We assume that these conjectures may be biased. In particular, we consider the possibility that taxpayers believe that their degree of tax compliance is larger than the mean of the society. In that case, we say that individuals make pessimistic conjectures about society's tax morale. We are interested in analyzing the effect of these conjectures on political outcomes.

Kantian ethics were originally applied to macroeconomics by Laffont

(1975). He used this assumption to justify some ethical behaviors in numerous populations subjected to macroeconomic constraints. Other more recent studies such as Federsen (2004) introduced this framework in a model in which voters are assumed to be ethical in a Kantian manner to explain the voting paradox. A more axiomatic study is that of Roemer (2010), who defined a new game theory equilibrium concept, which he called Kantian Equilibrium, and showed some of its applications.

To the best of our knowledge, the article closest to our framework is Boadway et al. (2007). They consider that taxpayers take into account whether their tax liabilities correspond to what they view as ethically acceptable in order to choose their labor supplies. If individuals find that the tax rate is ethical, then they choose their labor supplies without taking into account the tax rate. However, if it is not ethical for them, individuals behave egoistically, allowing taxes to distort their labor supplies. Broadway et al. found that labor supply becomes less elastic when individuals behave ethically. In comparison with their study, a limitation of our model is that individuals' pre-tax income is exogenously given and taxes do not distort the labor market. We do this for the sake of simplicity, and because our focus is on the formation and behavior of political parties that compete on income redistribution.

Regarding political competition, we consider that political parties are formed endogenously and they care about policy. We use the concept of the Endogenous Party Wittman Equilibrium (EPWE) proposed by Roemer (2001) in a framework in which two ideological parties compete in an election by proposing two income taxes. Parties face uncertainty about the probability of winning. One party is more in favor of income redistribution (Left Party) than the other (Right Party). Voters, who are taxpayers, vote sincerely for their preferred policy and the party with the highest share of the vote wins the election and implements the announced policy. The ideology of each party is endogenously determined by aggregating the preferences of its voters.

Political competition models with an EPWE have been used to explain a variety of policy outcomes such as the public good provision and its financing (Ortuño-Ortín and Roemer, 2000); the public versus private provision of social insurance programs (De Donder and Hindriks, 2006), the structure of the labor market (Lee and Roemer, 2005), and immigration policy (Llavador and Solano, 2011). Our analysis is closer to Ortuño-Ortín and Roemer (2000) because in both papers the policy outcome is the income tax, but we incorporate the possibility of tax avoidance.

The disadvantage of this methodology is that there is not usually a close form solution for the equilibrium and it is needed to resort to numerical simulations. We calibrate the model using data from the average of the EU-27 countries in 2010. We take data from Eurostat for income distribution and income tax rate, and from the World Bank for the size of the shadow economy (which we use as a proxy of the level of tax noncompliance).

Our main results are as follows. First, at equilibrium, the Left Party and Right Party propose a tax rate, respectively, above and below the optimal one for the median voter. Moreover, it predicts an expected tax rate and a rate of compliance very close to the ones reported by the data.

Second, the Left Party always reacts more intensively than the Right Party to changes in parameters of the model. This is because by incorporating the possibility of noncompliance, the Right Party gains a large fixed constituency who has strict preferences towards a minimum income taxation, while the Left Party's constituency has more variable preferences. Therefore, an increase in either the electorate's pessimistic bias about society's tax morale or the electorate's sensitivity to the social cost of tax avoidance makes the Left Party move their proposed tax rate more than the Right Party.

Pessimistic beliefs about society's tax morale make the Left Party heavily reduce their tax rate proposed in equilibrium, while it slightly increases the tax rate proposed by the Right Party. As voters become less confident about the aggregated level of tax compliance, they prefer a lower tax rate and a lower degree of compliance. This gives an advantage to the Right Party to win the elections and hence the probability that the Right Party will win increases in equilibrium. As a result, the expected implemented tax rate falls and the rate of evaders increases.

An increase in voters' sensitivity to the social cost of tax avoidance makes both parties propose a lower tax rate in equilibrium. This is because it makes every unit of tax burden evaded more costly in terms of utility, so it disincentives income taxation. This also gives an advantage to the Right Party to win the election. However, the effect of tax morale in tax compliance is less distorting than the effect of biased beliefs about society's tax morale because the former is symmetric for all individuals and orthogonal to private consumption. Consequently, an increase in voters' sensitivity to tax evasion has almost no effect on either the probability of winning or the share of tax evaders.

Finally, we analyze the effect of parties' uncertainty in equilibrium outcomes. As shown in Roemer (2001), an increase in parties' accuracy to forecast their vote share makes both parties converge to the optimal policy for the median voter in equilibrium. However, the Left Party converges faster than the Right Party. Again, the reason is the large share of an immobile Right Party's constituency with strict preferences. This gives an advantage to the Left Party to win the election and increases the Left Party's probability of winning. Therefore, the expected implemented tax rate is larger and the share of tax evaders decreases.

The rest of the paper is organized as follows. In section 2, we formally describe the model, and analyze voters' preferences for income redistribution given the previous preferences for tax compliance. In section 3, we focus on the political competition stage and define the equilibrium concept we use. In section 4 we calibrate the model and calculate the interior equilibria doing some comparative statics. Finally, in section 5 we conclude and discuss some results. All the proofs are in the Appendix.

2 The Model

Society is composed of a continuum of voters of mass equal to one. Voters are characterized by their pre-tax income $y_i \in (0, Y]$ according to probability distribution function $F(y_i)$ with mean $\overline{y} = \int_0^Y y_i dF(y_i)$ and median $y_m = [F]^{-1}(1/2)$. Voters have direct preferences over consumption (c_i) and the social cost produced by the perceived level of tax avoidance (A_i). Tax avoidance has a direct effect on the utility of voters that must be understood in a broad sense as a public bad. We assume this social impact to be increasing, at an inecreasing rate, in the amount of tax avoidance. Formally, we take the utility of a native to be

$$U_i(c_i, A_i) = c_i - \beta A_i^2$$

with $\beta > 0$.[2] Voters may not report their whole pre-tax income before taxes are levied. Let $x_i \in [0, 1]$ be the share of taxable income y_i reported by a voter i, so the the amount of tax avoidance by this voter can be measured by $(1 - x_i)y_i$.

[2]For the sake of exposition we assume constant marginal utility of consumption. However, it can be proven that the main results of the paper are preserved under a limited decreasing marginal utility of consumption.

Voters face uncertainty about the degree of the aggregated level of tax compliance. That is, they face uncertainty about the mean of the distribution of the share of taxable income reported by voters once voters have decided their degree of tax compliance, which is denoted by $\overline{x}$. Let $\overline{x}_i^e \in [0, 1]$ be voter i's expected value of the aggregated level of tax compliance in society. We assume that voters are ethical in a Kantian manner in the sense that they use their own level of tax compliance x_i as a reference to predict the aggregated level of tax compliance. More precisely, we assume that all voters have the same structure of conjectures about the aggregate level of tax compliance, which are as follows:

$$\overline{x}_i^e = \theta x_i + \epsilon_i$$

where $\theta \in (0, 1]$ stands for the possible pessimistic bias about the aggregated degree of tax compliance, and $\epsilon_i \in [-1, 1]$ is a random error term with zero mean and standard deviation σ. Notice that this structure of conjectures coincides with rational expectations when $\theta = 1$. However, our assumed structure of beliefs is more general because, on average, expectations about tax compliance may have a pessimistic bias whenever θ is smaller than one. Notice also that the beliefs about the aggregated level of tax compliance do not depend on individuals' income, i.e. voters believe that the degree of tax avoidance and income are independent variables.

The perceived aggregated level of tax avoidance for a voter i is defined as the perceived average of tax revenues avoided. Formally, it takes the following expression:

$$A_i = t(1 - \overline{x}_i^e)\overline{y}$$

Government is formed by the winner of an electoral process that we will describe later on. The goal of government is to redistribute income. To do so it has two policy instruments: an income tax, t, and a public transfer, b. Let b_i be voter i's expected level of public transfer that depends on $\overline{x}_i^e$. We assume that all voters believe that the government budget constraint is balanced, that is, for all voters:

$$b_i = t\overline{x}_i^e\overline{y} \tag{1}$$

Therefore, government actually has to define one policy instrument since the other is given by their commitment to balance the budget. We choose the tax rate as the strategic policy variable. Notice that given a tax rate implemented by the government, the public transfer implemented, b, may not match all voters' expectations. This is because they fail to forecast the aggregated level of tax compliance. We are aware that in a dynamic setting voters may react to this mismatch between conjectures and real policy. However, as voters and politicians seems to be short-run players, it is not hard to find examples in which this mismatch has not had future electoral consequences. [3]

We propose a model described by the following stages:

1. Political parties announce simultaneously their political platforms formed by a tax rate.

2. Elections take place and voters vote for the political platform they most prefer.

3. The winner of the election implements its announced polical platform.

4. Voters decide their level of tax compliance given the implemented tax rate and their beliefs about the aggregated level of tax compliance.

5. Taxes are levied, public transfers are paid and consumption is realized.

These stages induced a game form. This game form is solved by backward induction where the parties' competition stage is solved according to Wittman Equilibrium (which is defined next). Solving the game by backward induction means solving first voter‘s decision, and second, solving the parties‘ optimal policy accounting for voter's subsequent optimal decision. To do that, first, we analyze voters preferences for tax compliance, second we characterize voters preferences over the political instrument, i.e. the tax rate, and finally we analyze the behavior of political parties.

[3]Moreover, in a repeated setting, expectation about tax avoidance are updated so voters may forecast that richer voters report a lower proportion of their income than poor voters do.

2.1 Voters' decisions about tax evasion

Given the tax rate imposed by the government, voters form their conjectures about the total tax revenue, and they correspondingly decide their optimal level of tax compliance.

We assume that voters spend all their post-tax income, so consumption can be expressed as:

$$c_i = (1-t)x_i y_i + (1-x_i)y_i + b_i \Leftrightarrow$$

$$c_i = y_i - t x_i y_i + b$$

Individuals decide to declare a proportion of income such that their expected utility is maximized:

$$\begin{array}{cc} \max\limits_{x} & y_i + b_i - t x_i y_i - \beta A_i^2 \\ & b_i = t\overline{x}_i^e \overline{y} \\ \text{s.t.} & A_i = t(1-\overline{x}_i^e)\overline{y} \\ & \overline{x}_i^e = \theta x_i + \epsilon_i \end{array}$$

The first-order condition is as follows:

$$\underbrace{t(\theta\overline{y} - y_i)}_{\text{Redistribution Effect}} + \underbrace{2\beta(t\overline{y})^2(1-(\theta x_i^* + \epsilon_i))\theta}_{\text{Responsibility Effect}} = 0 \tag{2}$$

The individual decision of tax avoidance has two potential effects on welfare. First, there is an effect on private consumption that could be positive or negative depending if voters believe that they benefit from income redistribution or not. We call this effect the *redistribution effect.* Second, there is a positive effect on voters' welfare because, by increasing tax compliance, they reduce their perceived social cost of tax avoidance. We call this effect the *responsibility effect.*

Voters who perceive themselves as net benefitted from income redistribution (so they have both positive *redistribution and responsibility effects)* prefer to report their whole taxable income. This is the case for voters with a low enough income. More precisely, this is the case for voters with an income such that $y_i \leq \theta\overline{y}$. Otherwise, there is a trade-off between the *responsibility effect* and the *redistribution effect* when the latter is negative, that is, when voters believe that they are net contributors regarding income redistribution because their income is larger than the perceived average taxable income, i.e. $y_i \leq \theta\overline{y}$. Therefore, a positive level of tax avoidance may be optimal for these voters.

In the following proposition we characterize voters' optimal level of tax compliance.

Proposition 1 *The optimal level of tax compliance for a voter (x_i^*) is given by:*

$$x^* = \begin{cases} 1 & \text{if } y_i \leq \theta g(1-\epsilon_i-\theta) \\ \frac{\theta g(1-\epsilon_i)-y_i}{\theta(g(\theta)-g(0))} & \text{if } y_i \in (\theta g(1-\epsilon_i-\theta), \theta g(1-\epsilon_i)) \\ 0 & \text{if } y_i \geq \theta g(1-\epsilon_i) \end{cases}, \text{ and} \tag{3}$$

where $g(z) = (1 + 2\beta t\overline{y}z)\overline{y}$.

The structure of voters' preferences about tax evasion crucially depends on the perception voters have on whether they are net benefitted from income redistribution or not. In fact, only voters with an intermediate income relative to their pessimistic bias about the aggregated level of tax compliance do not have extreme preferences on tax compliance. These are voters who face a negative *redistribution effect*, so they believe they are net contributors to income redistribution, and this makes them prefer to reduce their reported taxable income. However, they also care about tax avoidance, which makes them increase their reported taxable income. This trade-off causes voters not to choose an extreme level of tax compliance.

In the next proposition we state the relationship between voters' pre-tax income and their optimal level of tax compliance.

Proposition 2 *Voters' optimal level of tax compliance is weakly decreasing in their pre-tax income.*

The intuition behind Proposition 2 comes from the fact that tax evasion is a way to avoid income redistribution. Therefore, as voters become richer they face a larger cost of reporting taxable income. Moreover, voters' social cost of tax avoidance does not depend on individuals' income but on the mean income.

Let us now analyze how individuals with the same income react to changes in the conjectures about the aggregated level of tax compliance, that is, the effect of a change in θ. Notice that a change in θ only affects voters who have a negative *distribution effect,* that is, voters that perceive themselves as net contributors to income redistribution. By *(2)* an increase in θ makes the *redistribution effect* less negative by pushing those voters for a higher tax compliance. However, the sign of the effect on the responsibility effect is not clear. The following proposition states that the result of the latter potential trade-off depends on the size of θ.

Proposition 3 *An increase in θ reduces the size of the group of voters who do not report their whole taxable income. However, it also reduces the optimal level of tax compliance for those voters who do not report their whole taxable income.*

The first statement of the proposition is explained by the effect of the pessimistic bias about the aggregated level of tax compliance upon the *redistribution effect.* That is, as the pessimistic bias about the aggregated level of tax compliance decreases, more taxpayers believe that they are net benefactors from the social transfer. More taxpayers will then decide to report their whole taxable income (and the poorest taxpayer who starts to evade taxes will now be reacher than before).

However, for those taxpayers who are rich enough and perceive themselves to be net contributors to the social transfer, a reduction in the pessimistic bias reduces their optimal level of tax compliance. This is because now the *responsibility effect* becomes smaller for all taxpayers given that a smaller proportion of the population is avoiding taxes. The latter pushes down the desired level of tax compliance for these tax evaders.[4]

Finally, we do comparative statics regarding the government instrumental policy, i.e., the tax rate. Again, only voters with intermediate income levels have an optimal share of reported taxable income that depends on the tax rate. The following proposition states the relation between the tax rate and the optimal level of tax compliance for those voters.

Proposition 4 *The optimal level of tax compliance is weakly increasing in the tax rate for all voters.*

This result comes directly from the marginal utility of the aggregated level of tax compliance in society. The higher the size of potential tax revenues the

[4] The fact that more optimism about tax compliance increases some individuals' level of tax avoidance might be seen more as a hypocritical behavior than an ethical one.

larger the potential utility because of tax compliance. This concern drives voters to prefer to report a larger proportion of their taxable income when the size of the welfare state is larger. In this context, the tax rate can be seen as a government policy to fight tax avoidance: the larger the tax rate, the higher the moral cost of tax avoidance and hence the larger the degree of tax compliance. Therefore, we can expect that parties that are more concerned about tax compliance will offer a high tax rate.

This result seems counterintuitive as it confronts Laffer curve's main result: there is a tax rate that increasing tax rates beyond that level will be counter-productive for raising further tax revenue. The reason is that taxes do not affect incentives to work in our model, so they do not distort the economy. Moreover, the only motivation that relatively rich individuals have for tax compliance is a moral motivation. This result may apply to Scandinavian countries where both tax rates and tax morale are high. However, we are aware that the result in Proposition 4 would be the opposite for high tax rates in an economy where taxes could distort economic behavior.

2.2 Voters' preferences on income redistribution

Once we have analyzed voters' decisions about tax compliance we can characterize their preferences over the tax rate. In the previous section we prove that voters' preferences over tax compliance depends on: first, voters' conjectures about the aggregated level of tax compliance and second, voters' pre-tax income.

Substituting the optimal share of reported taxable income , x_i^*, for voters' utility function, we obtain the general expression of voters' indirect utility function, which is given by the following expression:

$$v(t) = y_i + tx_i^*(\theta\overline{y} - y_i) + t\epsilon_i\overline{y} - \beta t^2(1 - \theta x_i^* - \epsilon_i)^2\overline{y}^2 \tag{4}$$

As stated in Proposition 1, voters prefer a different degree of tax compliance depending on their pre-tax income. These income boundaries are also effective for determining voters' preferences for income redistribution. Substituting the optimal level of tax compliance for voters, x^*, in the expression above, we obtain the following segmented indirect utility function:

$$v_i(t) = \begin{cases} y_i + t((\theta+\epsilon_i)\overline{y} - y_i) - \beta t^2(1-\theta-\epsilon_i)^2\overline{y}^2 & \text{if } y_i \leq \theta g(1-\epsilon_i-\theta) \\ y_i - \frac{1}{2\theta}[(2\theta+1)y_i - (2(\theta x_i^* + \epsilon_i)+1)\theta\overline{y}]t & \text{if } y_i \in (\theta g(1-\epsilon_i-\theta), \theta g(1-\epsilon_i)) \\ y_i - \beta(1-\epsilon_i)t^2\overline{y}^2 & \text{if } y_i \geq \theta g(1-\epsilon_i) \end{cases} \tag{5}$$

Using the expression above, we state the following proposition.

Proposition 5 *The optimal tax rate is equal to zero for all voters such that* $y_i > \theta g(1-\epsilon_i-\theta)$.

The optimal tax rate is zero for all voters with an income level such that they perceive themselves as net contributors to income redistribution. Otherwise, they may prefer a positive tax rate. We now explore preferences on income redistribution for voters who optimally prefer some degree of income redistribution, i.e., voters with a level of income y_i such that $y_i \leq \theta g(1-\theta-\epsilon_i)$. In this case, by maximizing the indirect utility function, (5) we obtain the following voters' optimal tax rate:[5]

$$t_i^* = \frac{(\theta+\epsilon_i)\overline{y} - y_i}{2\beta(1-\theta-\epsilon_i)^2\overline{y}^2} \tag{6}$$

Notice that this optimal tax rate can be also equal to zero or to one depending on both idiosyncratic variables (such as y_i and ϵ_i) and the pessimistic bias about the aggregated level of tax compliance i.e. θ. More precisely:

$$t_i^* = \begin{cases} 1 & \text{if } y_i \leq (\theta+\epsilon_i - 2\beta\overline{y}(1-\theta-\epsilon_i)^2)\overline{y} \\ \frac{(\theta+\epsilon_i)\overline{y}-y_i}{2\beta(1-\theta-\epsilon_i)^2\overline{y}^2} & \text{if } y_i \in (\theta+\epsilon_i - 2\beta\overline{y}(1-\theta-\epsilon_i)^2)\overline{y}, (\theta+\epsilon_i)\overline{y}) \\ 0 & \text{if } y_i \geq (\theta+\epsilon_i)\overline{y} \end{cases} \tag{7}$$

From (5) and (7) we fully characterize voters' preferences for income redistribution in the next proposition.

[5] The first-order condition of this maximization problem is as follows:

$$(\theta+\epsilon_i)\overline{y} - y_i - 2\beta t(1-\theta-\epsilon_i)^2\overline{y}^2 = 0$$

Therefore, the second order condition is satisfied.

Proposition 6 *If θ is large enough, the optimal tax rate for a voter i is given by the following expression:*

$$t_i^* = \begin{cases} 1 & \text{if } y_i \leq (\theta + \epsilon_i - 2\beta\overline{y}(1-\theta-\epsilon_i)^2)\overline{y} \\ \frac{(\theta+\epsilon_i)\overline{y}-y_i}{2\beta(1-\theta-\epsilon_i)^2\overline{y}^2} & \text{if } y_i \in ((\theta + \epsilon_i - 2\beta\overline{y}(1-\theta-\epsilon_i)^2)\overline{y}, y_H) \\ 0 & y_i \geq y_H \end{cases}$$

where $y_H = \arg\min\{\theta g(1-\epsilon_i-\theta), (\theta+\epsilon_i)\overline{y}\}$. Otherwise, t_i^* is only equal to either 0 or 1.

This proposition highlights the importance of bias in voters' conjectures about tax compliance on voters' preferences for income redistribution. In fact, when the pessimistic bias in voters' beliefs about the average level of tax compliance is low enough, there are voters with an intermediate optimal tax rate. This is because a high tax rate favors poor voters, but increases the direct cost of tax avoidance. If voters believe that this direct cost is too high, then there is no room for a trade-off. Otherwise, if voters' pessimism is moderated, then some voters (the richest voters among those who report their entire taxable income) will face a trade-off between expropriating the rich and not facing any direct cost of tax avoidance.[6]

Summarizing, there are only three possible optimal tax rates for all voters: *i)* The extreme case of zero tax rate, which is the most preferred policy for voters with a high enough income; *ii)* the extreme case of full taxation, which is the optimal policy for voters with a low enough income; and *iii)* an intermediate tax rate, which is only optimal for voters with an intermediate income.

Regarding the relationship between voters' optimal tax rate and voters' conjectures about society's tax morale we state the following proposition.

Proposition 7 *The optimal tax rate is weakly increasing in θ for all voters.*

Notice by (4) that an increase in the confidence in society's tax morale positively affected the indirect utility function because it increases the redistributive effect of public transfers and also reduces the negative effect of tax

[6]Notice also that Proposition 6 could be stated in terms of the idiosyncratic error in voters' beliefs, ϵ_i, instead of in terms of voters' bias in beliefs about tax morale. That is, it would have been equivalent to stating "for ϵ_i small enough," instead of "if θ is large enough" in the proposition.

evasion. Therefore, as society's confidence in tax morale increases, voters who report their whole income for any tax rate will prefer a larger tax rate .

In the next section, we analyze the political competition stage that determines the implemented tax rate. We describe the political process as a competition between policy-oriented parties (that is, parties that care about the policy finally implemented) rather than using the classical Dowsian model. In the latter model the policy offered by both parties will be simply the optimal tax rate for the median voter's policy. Since we believe that the behavior of parties is not purely opportunistic, we choose to define the equilibrium policy as the outcome of the Endogenous Party Wittman Equilibrium (EPWE) proposed by Roemer (2001) as an extension of the Wittman equilibrium in which parties' preferences are endogenously determined.

Notice that we have two idiosyncratic variables that characterize voters: the income level, y_i, and the error term associated to the expected value of the aggregated level of income compliance, ϵ_i.For the sake of simplicity we assume that these errors will be close enough to zero to be neglected (we know that on average they are zero). Incorporating errors does not add any new insight but complicates the calculus of equilibria in the political competition stage quite a bit.

Finally, we focus on the interior equilibria, ruling out the extreme cases in which a party offers either a zero tax rate or full taxation.[7]

3 Political Competition

Once we have characterized voters' preferences on tax rate we study the political competition stage. To do that we assume that there are two parties (labeled L and R) competing under majority rule that simultaneously announce their tax rate policies. Voters vote for their preferred policy, and the party with the most votes wins and implements the policy announced during the campaign.

Formally, given a pair of policy announcements t_L and t_R, let $\Omega(t_L, t_R)$

[7]Notice that this is the equilibrium of the benchmark scenario in which voters only care about consumption. As there is no *responsibility effect* without tax morale, voters who perceived themselves as net contributors of redistribution will prefer $x = 0$ and $t = 0$ and those who perceived themselves as net benefactors will prefer $x = 1$ and $t = 1$. Therefore, the median voter will have either one or another type of extreme preferences and political equilibrium will result on the implementation of one of these extreme optimal policies.

be the set of voters who prefer t_L to t_R. That is:

$$\Omega(t_L, t_R) = \{y_i \in (0, Y] : v(t_L; y) \geq v(t_R; y)\}$$

Using (5), and for $t_L > t_R$, we have

$$\Omega(t_L, t_R) = \{y_i \in (0, Y] : y \leq \Psi(t_L, t_R)\}, \tag{8}$$

where $\Psi(t_L, t_R) = (\theta - (t_L + t_R)\beta\overline{y}(1-\theta)^2)\overline{y}$ represents the dividing voter, that is, a voter that is indifferent between the Left Party and the Right Party. Notice that it is straightforward from the definition of $\Psi(t_L, t_R)$ that a more optimistic view about society's tax morale (higher θ), ceteris paribus, increases party L's set of voters.

Let $\Phi(t_L, t_R)$ be the proportion of voters voting for party L, corresponding to the measure of the set $\Omega(t_L, t_R)$. Hence, we can compute

$$\Phi(t_L, t_R) = \int_{\Omega_i(t_L, t_R)} dF(y_i)$$

Parties face electoral uncertainty in the sense that they know the pool of their supporters, but can only forecast the share of the vote they will receive with a margin of error Δ. Formally, we follow the "error-distribution model" presented in Roemer (2001, p.45). Let parties L and R propose t_L and t_R, respectively. Then, the proportion of votes that party L expects to receive is a random variable uniformly distributed on the interval $(\Phi(t_L, t_R) - \Delta,\ \Phi(t_L, t_R) + \Delta)$ for some $\Delta > 0$. It follows that the probability that party L will defeat party R is given by

$$p(t_L, t_R) = \begin{cases} 0 & \text{if } \Phi(t_L, t_R) + \Delta \leq 1/2 \\ \frac{\Phi(t_L, t_R) + \Delta - 1/2}{2\Delta} & \text{otherwise} \\ 1 & \text{if } \Phi(t_L, t_R) - \Delta \geq 1/2. \end{cases},$$

and that party R will defeat party L with probability $1 - p(t_L, t_R)$.

Parties have policy preferences representing the average utility of their members (Wittman 1973). The constituents of party L are denoted by the sets of voters Ω^L, and the constituents of party R are denoted by the sets of voters Ω^R. Thus, the average utility function of party J's constituents for a policy t is given by:

$$V^J(t) = \int_{\Omega^J} v_p(t; y) dF_p(y) \tag{9}$$

Given a distribution of voter preferences, a political equilibrium provides: *i*) a partition of the polity into two parties, labeled L and R, respectively; *ii*) the platform that each party proposes; and *iii*) the expected vote share of each party.

Both parties simultaneously choose the platform that maximizes their expected utility given the platform proposed by the other party. At equilibrium, the following two conditions must be satisfied: (1) no party prefers to change its platform given both the platform of the other party and the partition of the polity; and (2) no party's constituent wants to change its membership given the two parties' platforms.

Definition 8 *An* ***Endogenous Parties Wittman Equilibrium (EPWE)*** *is a pair of policies* $(t_L^*, t_R^*) \in [0,1]^2$ *and a partition of the polity* Ω_i^L, Ω_i^R *such that:*

1. *Given* Ω_i^L *and* Ω_i^R,

$$t_L^* = \arg\max\ p(t, t_R^*)V^L(t) + (1 - p(t, t_R^*))V^L(t_R^*), \text{ and} \tag{10}$$

$$t_R^* = \arg\max\ p(t_L^*, t)V^R(t_L^*) + (1 - p(t_L^*, t))V^R(t). \tag{11}$$

2. *Given* t_L^* *and* t_R^*,

$$\text{if } y \in \Omega_i^L, \text{ then } v_i(t_L^*; y) \geq v_i(t_R^*; y), \text{ and} \tag{12}$$

$$\text{if } y \in \Omega_i^R, \text{ then } v_i(t_R^*; y) \geq v_i(t_L^*; y). \tag{13}$$

The first-order conditions for the maximization problems (10) and (11) show the trade-off between proposing a policy closer to the interests of each party's constituency and the corresponding decrease in the probability of victory:

$$\left[p(t_L^*, t_R^*)\frac{\partial V^L(t)}{\partial t}\right] + \left[\frac{\partial p(t, t_L^*)}{\partial t}(V^L(t) - V^L(t_L^*))\right] = 0$$

$$\left[(1-p(t_L^*,t_R^*))\frac{\partial V^R(t)}{\partial t}\right]+\left[-\frac{\partial p(t_L,t)}{\partial t}(V^R(t)-V^R(t_L^*))\right]=0$$

At equilibrium, the constituency of each party is determined endogenously by expressions (12) and (13). From (8), and given the equilibrium policies $t_L^* > t_R^*$, the constituency or each party is fully characterized by a level of income Ψ^*, so that voters with income such that $y < \Psi^*$ constitute party L, while the rest constitute party R.

Therefore, finding an interior equilibrium requires solving the following systems of three equations in the three unknowns t_L, t_R, and Ψ:[8]

$$\left[p(t_L^*,t_R^*)\frac{\partial V^L(t)}{\partial t}\right]+\left[\frac{\partial p(t,t_L^*)}{\partial t}(V^L(t)-V^L(t_L^*))\right]=0$$
$$\left[(1-p(t_L^*,t_R^*))\frac{\partial V^R(t)}{\partial t}\right]+\left[-\frac{\partial p(t_L,t)}{\partial t}(V^R(t)-V^R(t_L^*))\right]=0$$
$$\Psi=\Psi(t_L^*,t_R^*)$$

4 Calibration and Numerical Results

We calibrate the model using data for countries in EU-27 for the year 2010. To compute political equilibria we need values for $\overline{y}$, y^m, θ, β and Δ. We assume that income distribution follows a log normal distribution with mean and median income respectively, $\overline{y} = 30,648$ and $y^m = 26,079$ (in euros). [9]

Using equation (6), the values of θ are restricted in order to have an interior optimal tax rate for the median voter. In particular $\theta \geq 0.851$ to have a non negative optimal tax rate for the median voter. This is because in order to have a positive optimal tax rate for the median voter we need:

$$\frac{\theta\overline{y}-y^{med}}{2\beta(1-\theta)^2\overline{y}^2}>0\Leftrightarrow$$

[8] Using (5) and (8) we can prove that the second order conditions are satisfied

[9] Eurostat reports mean annual gross earnings but not median annual gross earnings. However, they report mean and median hourly gross earnings. We use the ratio betwen mean and median hourly gross earnings to calculate the median anual gross earnings. The data are available at this link:

http://appsso.eurostat.ec.europa.eu/

$$\theta\overline{y} > y^{med} \Leftrightarrow$$

$$\theta > \frac{y^{med}}{\overline{y}} = 0.851$$

To calibrate the parameters β and θ, we use equations (6) and (3). We need data on both the optimal tax rate for the median voter, and the threshold in income such that voters with an income higher than that start evading taxes.

According to Eurostat data, the average EU-27 personal income tax rate for a single individual without children with 80% of average earnings in 2010 was 0.2737. Additionally, data from World Bank (see Schnaider et al., 2010) indicate that the average size of the shadow economy for countries in EU-27 is 22.1% of total economic activity.

First, using the calibrated income distribution function, we calculate the threshold income for tax evaders in equation (3). In particular, we find that all voters with earnings above $40,366$ euros a year prefer not to report their whole taxable income.

Assuming that the implemented tax rate is the optimal for the median voter, we calibrate the parameters β and θ solving the following two equations systems:[10]

$$\left.\begin{array}{c} \theta(1+2\beta\overline{y}(1-\theta)0.2737)\overline{y} = 40,366 \\ \frac{\theta\overline{y}-y^{med}}{2\beta(1-\theta)^2\overline{y}^2} = 0.2737 \end{array}\right\} \Rightarrow \begin{array}{c} \theta = 0.89832 \\ \beta = 0.273274 \end{array}$$

We adjust the margin of error in forecasting the share of the vote to 3%, i.e. $\Delta = 0.03$, for the baseline calculations in order to get EPWEs that are consistent with our data.

Table 1 shows the baseline EPEWEs (in italics) and a comparative static regarding the parameters β, θ, and Δ. In particular, we show the equilibrium tax rate proposed by the Left and Right Parties denoted by **tL** and **tR**, respectively; the probability of winning for the Left Party denoted by **ProbL**; the share of the vote cast by the Left Party denoted by

[10] As it is proven in Roemer (2001), we know that party L and R's policy proposals at non-trivial equilibria are above and below the optimal tax rate for the median voter, respectively. Moreover, in the caseof no uncertainty, both parties would propose the optimal tax rate for the median voter (see Roemer 2001). We choose this value as the *status quo*.

%votesL; the expected implemented tax rate denoted by $\mathbf{E[t]}$ where $\mathbf{E[t]} = \mathbf{ProbL} * \mathbf{tL} + (\mathbf{1} - \mathbf{ProbL}) * \mathbf{tR}$; and the share of the voters who do not report their whole taxable income denoted by **%avoidance**.

Table 1. Interior EPWEs

θ	**tL**	**tR**	**ProbL**	**%votesL**	**E[t]**	**%avoidance**
0.88	0.258	0.030	0.421	49.529	0.126	32.381
0.90	*0.454*	*0.027*	*0.579*	*50.472*	*0.274*	*22.074*
0.92	0.908	0.023	0.761	51.563	0.696	9.727

a. EPWE depending on θ

β	**tL**	**tR**	**ProbL**	**%votesL**	**E[t]**	**%avoidance**
0.15	0.825	0.033	0.591	50.543	0.501	22.028
0.27	*0.454*	*0.027*	*0.579*	*50.472*	*0.274*	*22.074*
0.40	0.311	0.021	0.573	50.438	0.187	22.092

b. EPWE depending on β

Δ	**tL**	**tR**	**ProbL**	**%votesL**	**E[t]**	**%avoidance**
0.05	0.568	0.027	0.421	49.529	0.126	32.381
0.03	*0.454*	*0.027*	*0.579*	*50.472*	*0.274*	*22.074*
0.02	0.394	0.027	0.725	50.899	0.293	20.927

c. EPWE depending on Δ

First, our calibrated model predicts an expected tax rate of 0.274 which is very close to the one reported by Eurostat for the average EU-27 personal income tax rate for a single individual without children with 80% of average earnings in 2010. Moreover, it also predicted a share of voters who do not report their whole taxable income of 22.074%, which is very close to the average size of the shadow economy for countries in EU-27 reported by the World Bank.

Second, a general view of Table 1 shows that there exists a high divergence in parties' policy platforms. This divergence is explained by the large polarization of voters' preferences on the tax rate.[11] It is also interesting to note that the Left Party always reacts more intensively than the Right Party regarding policy platforms to changes in parameters of the model. The reason is that the Right Party has a large fixed constituency with strict preferences on zero tax rate, while the Left Party's constituency has more variable preferences. [12]

Third, regarding comparative static, we select a range of parameters values to analyze non trivial equilibria, that is equilibria in which parties' proposals diverge, i.e. $t_L \neq t_R$ and there is no party that wins with probability equal to one, i.e. $p(t_L, t_R) \in (0, 1)$.[13] However, looking at the results on Table 1, one may realize for which parameter's values trivial equilibria are obtained.

Panel a. in Table 1 shows that a decrease in voters' confidence in society's tax morale (i.e. a decrease in θ) makes the Left Party heavily reduce their tax rate proposed in equilibrium. However, it slightly increases the tax rate proposed by the Right Party. As a consequence, the Left Party's probability of winning decreases.

As we have seen in the previous section, an increase in the pessimistic bias in voters' beliefs about society's tax morale push preferences for redistribution down, giving the Right Party an advantage to win the election. In order to not lose many votes, the Left Party drastically reduces its proposed tax rate, thus sacrificing the utility of its more radical members. However, the Right Party benefits from this advantage by increasing their proposed tax rate only slightly**.** Finally, the expected implemented tax rate falls and the share of tax evaders increases.

Voters' sensitivity towards the social cost of tax avoidance has a generalized effect in equilibrium parties' policy platforms. It is shown in Panel b. that an increase in voters' sensitivity to the social cost of tax avoidance (i.e. an decrease in β) makes both parties propose a lower tax rate**.** This

[11] Polarization in voters' preferences on tax rate is given by the specification of the assumed voters' utility function which is linear in consumption. A logarithmic specification may produce smoother results. However, the main insights of the paper would not change.

[12] Recall that in the calibrated model the median voter prefers a tax rate of 0.2737. This tax rate is closer to the optimal one for the Right Party's extreme constituency than for the Left Party's extreme constituency.

[13] A Wittman equilibrium (t_L, t_R) is defined by Roemer as trivial if either $t_L = t_R$ or $p(t_L, t_R)$ takes values equal to 1 or 0. Theorem 3.4 in Roemer (2001) proves that this type of equilibria does not exist if the optimal tax rate of the median voter is neither 1 nor 0.

is because an increase in voters' sensitivity to tax avoidance makes every unit of tax burden evaded more costly in terms of utility, so it discourages income taxation. As in the case of the effect of voters' confidence on society's tax morale, it also gives the Right Party an advantage to win the election. However, the extent of the effect of voters' sensitivity to tax avoidance is much more reduced than the former. Consequently, an increase in voters' sensitivity to the social cost of tax avoidance has almost no effect on both the vote share and the level of tax compliance.

Finally, using Panel c. we analyze the effect of parties' accuracy to forecast their vote share on equilibrium outcomes. As uncertainty reduces, the Left Party converges rapidly to the optimal tax rate for the median voter while the Right Party practically does not move its policy platform. Again the reason is the large share of an immobile Right Party constituency with strict preferences. This gives the Left Party an advantage to win the election so it increases the probability that the Left Party will win. Therefore, the expected implemented tax rate is larger and it increases the level of tax compliance.

5 Concluding Remarks

In this paper we study how voters' views about society's tax morale may shape income redistribution. We present a model in which the implemented tax rate is the outcome of a political competition in which parties are formed endogenously and voters may not report their whole taxable income.

The main findings are as follows. First, regarding preferences for income redistribution, we find that only taxpayers who are poor enough prefer a nonzero tax rate. Consequently, they report their entire taxable income. Richer taxpayers prefer no taxation and they evade in case a positive tax rate is implemented.

Secondly, regarding political competition, at equilibrium, partisan parties propose different tax rates above and below the optimal one for the median voter. We name the Left (Right) Party the one that proposes the highest (lowest) tax rate. Moreover, we find that the Right Party's constituency has more strict preferences than the Left Party's constituency. This causes the Right Party to always react less intensively than the Left Party does to changes in parameters of the model.

Finally, we find that parties' probability of winning in equilibrium is affected by two factors: The degree of pessimism in voters' concerns about society's tax morale, and the level of parties' electoral uncertainty. More precisely, we find that an increase in the pessimistic bias in voters' conjectures about society's tax morale increases the Right Party's probability of winning in equilibrium. Hence, the expected implemented tax rate falls and the level of tax compliance decreases. However, an increase in parties' accuracy to forecast their vote share increases the Left Party's probability of winning. This increases the expected implemented tax rate and also increases the level of tax compliance.

From these results we can expect that right parties will tend to increase the pessimistic view of voters about society's tax morale, while left parties will push voters' optimism.

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A Appendix

Proof of Proposition1. Let us first characterize voters preferences on x. The first-order condition of the maximization utility maximization problem with respect to the decided level of tax evasion is as follows:

$$t(\theta\overline{y}-y)+2\beta(t\overline{y})^2(1-\theta x-\epsilon_i)\theta=0 \Leftrightarrow$$
$$1-\theta x-\epsilon_i=\frac{y-\theta\overline{y}}{2\beta\theta t\overline{y}^2} \Leftrightarrow$$
$$x^*=\frac{(1+2\beta t\overline{y}(1-\epsilon_i))\theta\overline{y}-y}{2\beta t\overline{y}^2\theta^2}$$

We know that x^* must belong to the interval $[0,1]$. This is the case when:

$$0\leq\frac{(1+2\beta t\overline{y}(1-\epsilon_i))\theta\overline{y}-y}{2\beta t\overline{y}^2\theta^2}\leq 1, \text{ and}$$

This inequality can be reduced to the following:

$$(1+2\beta t\overline{y}(1-\theta-\epsilon_i))\theta\overline{y}\leq y\leq(1+2\beta t\overline{y}(1-\epsilon_i))\theta\overline{y} \tag{15}$$

Hence, for individuals with $\theta\leq 1$, the optimal level of tax evasion is:

$$x^*=\begin{cases} 1 & \text{if } y\leq(1+2\beta t\overline{y}(1-\theta-\epsilon_i))\theta\overline{y} \\ \frac{(1+2\beta t\overline{y}(1-\epsilon_i))\theta\overline{y}-y}{2\beta t\overline{y}^2\theta^2} & \text{if } y\in((1+2\beta t\overline{y}(1-\theta-\epsilon_i))\theta\overline{y},(1+2\beta t\overline{y}(1-\epsilon_i))\theta\overline{y}) \\ 0 & \text{if } y\geq(1+2\beta t\overline{y}(1-\epsilon_i))\theta\overline{y} \end{cases} \tag{16}$$

Defining the function $g(z)=(1+2\beta t\overline{y}z)\overline{y}$, we can rewrite expressions (16) as follows:

$$x^*=\begin{cases} 1 & \text{if } \frac{y}{\theta}\leq g(1-\theta-\epsilon_i) \\ \frac{\theta g(1-\epsilon_i)-y}{\theta(g(\theta)-g(0))} & \text{if } \frac{y}{\theta}\in(g(1-\theta-\epsilon_i),g(1-\epsilon_i)) \\ 0 & \text{if } \frac{y}{\theta}\geq g(1-\epsilon_i) \end{cases}$$

■

Proof of Proposition 2. From Proposition 1 we have that voters with income y have an optimal level of tax evasion given by this expression:

$$x^*=\begin{cases} 1 & \text{if } \frac{y}{\theta}\leq g(1-\theta-\epsilon_i) \\ \frac{\theta g(1-\epsilon_i)-y}{\theta(g(\theta)-g(0))} & \text{if } \frac{y}{\theta}\in(g(1-\theta-\epsilon_i),g(1-\epsilon_i)) \\ 0 & \text{if } \frac{y}{\theta}\geq g(1-\epsilon_i) \end{cases}$$

where $g(z) = (1 + 2\beta t\overline{y}z)\overline{y}$. It is straightforward to see that $\frac{dx^*}{dy} \leq 0$ for all voters with income $y \in (0, Y]$. ■

Proof of Proposition 3. Let us prove the first statement of the **proposition**. The size of the population that **reports** their whole taxable income are those with an income such that $y \leq (1+2\beta t\overline{y}(1-\theta-\epsilon_i))\theta\overline{y}$. An increase in θ increases the size of this group if and only if:

$$\frac{d(1 + 2\beta t\overline{y}(1 - \theta - \epsilon_i))\theta\overline{y}}{d\theta} > 0$$

Computing the derivative we have the following:

$$\frac{d(1 + 2\beta t\overline{y}(1 - \theta - \epsilon_i))\theta\overline{y}}{d\theta} = \overline{y} - 2\beta t\overline{y}(2\theta + \epsilon_i - 1) > 0$$

$$\overline{y} - 2\beta t\overline{y}(2\theta + \epsilon_i - 1) > 0 \Leftrightarrow$$

$$\theta + \epsilon_i < 1 + \frac{1}{2\beta t\overline{y}}$$

However, this is always true for any θ and ϵ_i because the maximum level of $E[\overline{x}]$is equal to one.

Let us now prove the second statement of the proposition. For individuals with the same y, an increase in θ leaves the optimal level of tax evasion unaltered for voters with an either high or low enough income. According to Proposition 1, x^* depends on θ only for intermediate income levels. More precisely,

$$x^* = \frac{(1 + 2\beta t\overline{y}(1 - \epsilon_i))\theta\overline{y} - y}{2\beta t\overline{y}^2\theta^2} \text{ for } \frac{y}{\theta} \in (g(1 - \theta - \epsilon_i), g(1 - \epsilon_i))$$

otherwise x^* is either 1 or 0. Calculating the derivative of x^* with respect to θ we obtain:

$$\frac{dx^*(\theta)}{d\theta} = \frac{(1 + 2\beta t\overline{y}(1 - \epsilon_i))2\beta t\overline{y}^3\theta^2 - 4\beta t\overline{y}^2\theta((1 + 2\beta t\overline{y}(1 - \epsilon_i))\theta\overline{y} - y)}{\left(2\beta t\overline{y}^2\theta^2\right)^2} \Leftrightarrow$$

$$\frac{dx^*(\theta)}{d\theta} = \frac{y - (1 + 2\beta t\overline{y}(1 - \epsilon_i))\theta\overline{y}}{2\beta t\overline{y}^2\theta^3} = -\frac{x^*(\theta)}{\theta} < 0 \text{ for all } x^* \in (0, 1).$$

■

Proof of Proposition 4. According to Proposition 1, x^* is constant for voters with low and high income levels. However, it is a function of t among other variables for voters with intermediate income levels. This function is given by the following identity:

$$x^* = \frac{(1 + 2\beta t\overline{y}(1 - \epsilon_i))\theta\overline{y} - y}{2\beta t\overline{y}^2\theta^2}$$

Calculating the derivative of $x^*(t)$ with respect to t, we obtain:

$$\frac{\partial x^*(t)}{\partial t} = \frac{-(\theta\overline{y} - y)}{2\beta\overline{y}^2\theta^2 t^2}$$

This is because voters with $x^*(t)$ are all such that their pre-tax income is larger than $\theta\overline{y}$. ■

Proof of Proposition 5. Using (5), it is straightforward to check that for voters with income such that $y_i \geq \theta g(1 - \epsilon_i)$, the optimal tax rate is equal to zero. However, for voters with income such that $y_i \in (\theta g(1-\theta-\epsilon_i), \theta g(1-\epsilon_i))$, it is not so straightforward to prove the same.

Substituting the optimal level of tax compliance x_i^* into (5), we have the following expression for the indirect utility function for voters with $y_i \in (\theta g(1 - \theta - \epsilon_i), \theta g(1 - \epsilon_i))$:

$$v_i(t) = y_i - \frac{1}{2\theta}\left[(2\theta + 1)y_i - \frac{(\theta\overline{y} - y)}{\beta t\overline{y}} + \theta(\overline{y}(3 - 2\epsilon_i) + 2\epsilon_i)\right] t \Leftrightarrow$$

$$v_i(t) = y_i - \frac{(y - \theta\overline{y})}{\beta\overline{y}} - \frac{1}{2\theta}\left[(2\theta + 1)y_i + \theta(\overline{y}(3 - 2\epsilon_i) + 2\epsilon_i)\right] t$$

And then $\frac{dv_i(t)}{dt} < 0$,so the optimal tax rate is zero for these voters. ■

Proof of Proposition 6. By (5) and (7) there are voters with an optimal tax rate $t_i^* \in (0, 1)$ if and only if:

$$(1 + 2\beta t_i^*\overline{y}(1 - \theta - \epsilon_i))\theta\overline{y} > (\theta + \epsilon_i - 2\beta\overline{y}(1 - \theta - \epsilon_i)^2)\overline{y}$$

Notice that voters with an optimal tax rate $t_i^* \in (0, 1)$ are such that $\overline{x}_i^e = \theta + \epsilon_i$. Then we can rewrite the inequality above as follows:

$$\theta > \frac{\overline{x}_i^e - 2\beta\overline{y}(1 - \overline{x}_i^e)^2}{1 + 2\beta\overline{y}t_i^*(1 - \overline{x}_i^e)}$$

Substituting $t_i^* = \frac{\overline{x}_i^e\overline{y}-y_i}{2\beta(1-\overline{x}_i^e)^2\overline{y}^2}$ we obtain:

$$\theta > \frac{(1-\overline{x}_i^e)\overline{y}(\overline{x}_i^e - 2\beta\overline{y}(1-\overline{x}_i^e)^2)}{\overline{y}-y_i}$$

However, $t_i^* \geq 0$ if and only if $y_i \leq \overline{x}_i^e\overline{y}$ and then,

$$\frac{(1-\overline{x}_i^e)\overline{y}(\overline{x}_i^e - 2\beta\overline{y}(1-\overline{x}_i^e)^2)}{\overline{y}-y_i} \leq \frac{(1-\overline{x}_i^e)\overline{y}(\overline{x}_i^e - 2\beta\overline{y}(1-\overline{x}_i^e)^2)}{\overline{y}-\overline{x}_i^e\overline{y}}$$

Therefore, if θ is such that:

$$\theta > \overline{x}_i^e - 2\beta\overline{y}(1-\overline{x}_i^e)^2 \geq \frac{(1-\overline{x}_i^e)\overline{y}(\overline{x}_i^e - 2\beta\overline{y}(1-\overline{x}_i^e)^2)}{\overline{y}-y_i} > 0,$$

there exists at least one voter i such that this voter i's optimal tax rate is $t_i^* = \frac{\overline{x}_i^e\overline{y}-y_i}{2\beta(1-\overline{x}_i^e)^2\overline{y}^2}$ such that $t_i^* \in (0,1)$.

Again, using (7), it is straightforward that voters' optimal tax rate is given by the following expression:

$$t_i^*(y_i,\epsilon_i) = \begin{cases} 1 & \text{if } y_i \leq (\overline{x}_i^e - 2\beta\overline{y}(1-\overline{x}_i^e)^2)\overline{y} \\ \frac{\overline{x}_i^e\overline{y}-y_i}{2\beta(1-\overline{x}_i^e)^2\overline{y}^2} & \text{if } y_i \in (\overline{x}_i^e - 2\beta\overline{y}(1-\overline{x}_i^e)^2)\overline{y}, y_H) \\ 0 & y_i \geq y_H \end{cases},$$

where $y_H = \arg\min\{\theta g(1-\overline{x}_i^e), \overline{x}_i^e\overline{y}\}$ ■

Proof of Proposition 7. By equations (5) and (7), t_i^* is constant for voters with a low and high income levels. However it is a function of θ among other variables for voters with intermediate income levels. This function is given by equation (6):

$$t_i^* = \frac{(\theta+\epsilon_i)\overline{y}-y_i}{2\beta(1-\theta-\epsilon_i)^2\overline{y}^2}$$

Calculating the derivative of t_i^* with respect to θ, we obtain:

$$\frac{\partial t_i^*(\theta)}{\partial\theta} = \frac{2\beta(1-\theta-\epsilon_i)^2\overline{y}^3 + 4\beta(1-\theta-\epsilon_i)\overline{y}^2((\theta+\epsilon_i)\overline{y}-y_i)}{(2\beta(1-\theta-\epsilon_i)^2\overline{y}^2)^2} > 0$$

This is because voters with t_i^* are all such that their pre-tax income y_i is smaller than $(\theta+\epsilon_i)\overline{y}$. ■