POLITICAL ECONOMY OF TAX EVASION UNDER PROBABILISTIC VOTING

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I hereby certify that this thesis meets all the requirements of the Graduate School of Social Sciences for a Master's degree.

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I have therefore fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

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Using a theoretical model of political competition, we study the conditions under which tax evasion persists as a political equilibrium outcome. In the model, voters belong to one of the two income classes: high (H) and low (L). Each member of a given income class receives the same income. There is an income tax levied at a flat rate. The tax proceedings are used to finance the single public good and the tax enforcement efforts, if any. Due to the sources of their income, some of the taxpayers from income class H can report their income as low. If there is any enforcement, it is to prevent those tax payers from under reporting. Both the equilibrium tax rate and equilibrium level of enforcement is determined endogenously, in the equilibrium of a two-party political competition game with probabilistic voting. The objective of each political party is to maximize its chance of an election victory.

We found that in the ensuing political equilibrium neither party proposes any tax enforcement. This result is robust to variations in the (i) fraction of high income voters in the society, (ii) fraction of the high income voters who can evade, (iii) the cost of tax enforcement and, (iv) the relative political power of the two income classes.

Keywords: Tax evasion, Election, Probabilistic Voting, Enforcement

ÖZET

OLASILIK OYLAMA MODELİ İLE VERGİ KAÇIRMANIN POLİTİK EKONOMİSİ

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Bu çalışma, vergi kaçırmanın hangi koşullar altında bir politik dengenin neticesi olduğunu, siyasi rekabetin teorik bir modelini kullanarak açıklamaktadır. Modelde, seçmenler iki gelir sınıfından birine aittir. Bir gelir sınıfının her bir üyesi aynı geliri elde etmektedir. Tüm gelir sınıfları için gelir vergisi oranı aynıdır. Toplanan vergi, kamu hizmeti ve eğer varsa, vergi toplama harcamalarını finanse etmek için kullanılmaktadır. Yüksek gelir sınıfına ait bazı seçmenler, gelir kaynaklarından dolayı, gelirlerini düşük olarak beyan edebilmektedir. Eğer bir vergi toplama harcaması varsa bu harcama, gelirini düşük beyan eden yüksek gelir sınıfına ait seçmenleri önlemek için kullanılmaktadır. Olasılık oylama modeli kullanılan iki partili bir siyasi rekabet oyunu dengesinde, denge vergi oranı ve denge vergi yaptırım düzeyi endojen olarak belirlenmektedir. Her bir siyasi partini amacı, seçim kazanma ihtimalini mümkün olduğu kadar arttırmaktır.

Oyunun dengesinde hiçbir partinin vergi kaçırmayı önleyici yaptırımları vaat etmeyeceği bulunmuştur. Bu sonuç, (i) yüksek gelir gurubuna mensup seçmenlerin toplumdaki oranından, (ii) vergi kaçırabilen yüksek gelir sınıfına mensup seçmenlerin toplumdaki oranından, (iii) vergi yaptırım maliyetinden ve (iv) iki gelir gurubunun birbirine göre siyasi gücünden bağımsızdır.

Anahtar Kelimeler: Vergi Kaçırma, Seçim, Olasılık Oylama, Vergi Yaptırımı

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CHAPTER ONE

INTRODUCTION

Tax evasion and the electoral competition is the main subject of this research. We consider a setup with vote maximizing parties and utility maximizing taxpayers who vote in a probabilistic fashion. There are two groups of voters (high and low income), a voter from an income group pays a certain fraction of her income as the tax. The collected tax revenue is used to finance a public good. A certain fraction of high income voters can evade their taxes, if the level of enforcement is sufficiently low. The tax rates for each income group as well as the level of enforcement are determined through the political process, i.e., during the electoral campaign, each party proposes a policy vector specifying its fiscal policy. The winning party implements its promise after the election. In this thesis, we will model this situation as a game and calculate its equilibrium. Using this equilibrium, we analyze the conditions for the existence and the persistence for tax evasion.

In a democratic and modern world, the elections play a key role in the sense that it affects both governed and governing parts' life quality. For any politician the winning strategy, and for any individual his expected utility, have an utmost importance. Finding the best solution for the society including politicians and voters would affect the individual's welfare, the education system, income redistribution transfers and, many other issues. So both politicians and individuals want to increase their welfare based on their promises and preferences for future i.e., during the electoral campaigns political parties propose policies to win the majority of the votes, and the voters want to maximize their expected utilities with respect to policy platforms that they are offered. A voter makes the decision between tax compliance and non-compliance based on governments' fiscal policy, its expected utility from after-tax income and public goods delivered. Given this behavior, we study the equilibrium fiscal policy when each party tries to maximize its vote share.

In the literature, what determines the rates and how these affect the voters, have been explained using different models. Most common among these, is the deterministic voting models with the resulting median voter theorem. However, when the policy is multi-dimensional, median voters' theorem is not applicable due to cycling. In these situations, the utility functions of parties are discontinuous in their policy platforms, and a Nash equilibrium often fails to exist. One way of dealing with the situation is to extend the standard voting models to probabilistic voting models, where the payoff functions of different parties are smooth in policies, which assures the existence of an equilibrium.

This dissertation investigates tax compliance and the electoral competition in competitive democracies. We examine the model, where voters belong to one of the two income classes: high (H) and low (L). There are two political parties, A and B. In elections each party proposes a fiscal policy platform (a tax rate, a public good level and an enforcement policy). The politicians may differ from each other in popularity, due to politician's charisma, ethnicity, gender, ideology and religion etc. Further, the preferences of the voters on these issues are subject to random shocks; many other unforeseeable events that occur during a political campaign. Thus, a candidate's popularity is a random variable. Each member of a given income class receives the same income. There is an income tax levied at a flat rate. The tax proceedings are used to finance the single public good and the tax enforcement efforts, if any. Due to the sources of their income, some of the taxpayers from high income class can report their income as low. If there is any enforcement, it is to prevent those tax payers from under reporting, while low income individuals and some of the high income individuals cannot under report their income.

We analyze the political game between office-motivated politicians and self-interested voters. To explain how these political parties, choose their policies in such a setup we examine the set of undominated fiscal policy platforms of each politician. In section 4 we identify the possible strategies of politicians (and the possible preferences of voters based on probabilistic voting model). In section 5, we examine the equilibrium strategy profiles of political parties. The voters are trying to maximize their expected utility based on tax rates, government audit policy and public goods delivered. On the other hand, politicians are trying to maximize their winning probability by choosing tax rates, the enforcement policy and the public good level. In the model, high income taxpayers who can report low income, know the probability that they would be audited and fined. Given this information they try to maximize their expected utility by deciding both whether to evade or not and conditional on that decision whom to vote for. The rest of the voters, maximize their utility by deciding only whom to vote for. And the political parties compete against each other for winning the election by choosing their policy platforms.

In section 5.1, we analyze the relative magnitudes of the equilibrium policy platforms (tax rate level, public good level). Due to the high number of parameters, analyzing policy platforms is a sophisticated task. Therefore, we make certain assumptions and define various specific intervals to understand and compare the relative sizes of tax rates and public goods level under tax compliance and non-compliance. We find that public goods level under non-compliance is higher than that of under compliance for all possible values of parameters.

Section 5.2, presents the main result: for all possible values of parameters, tax evasion by those who can evade will be the unique equilibrium outcome. Note that, even if the population share of not-evading high income voters is more than the sum of population share of evading high income voters and low income voters, the equilibrium does not change but, the equilibrium tax rate under evasion decreases relatively. i.e., non-evading high income voters also choose no enforcement policy due to the lower level of tax rate and higher level of public good under evasion. In other words, enforcement is not an equilibrium.

CHAPTER TWO

LITERATURE REVIEW

Economic analysis of an individual's tax evasion decision as a result of an enforcement starts with the seminal work of Allingham and Sandmo (1972). They described tax evasion as a gamble. According to them, tax evaders want to maximize their expected utility when they know the fine they would be inflicted upon. The models developed later included the utility that the individuals obtain by paying their taxes decently. Myles and Naylor (1996). Slemrod and Yitzhaki (2002) described tax evasion being different from a simple gamble as it includes social effects as well.

For the political parties, different models have been put forward but the most appealing for our analysis is the probabilistic voting models. In these models, voters vote based on policy platforms, idiosyncratic ideologies and stochastic shocks (Persson and Tabellini, 2009). The voters are heterogeneous, the policy platforms that politicians choose may be in favor of some voters and have adverse effect for the others as a result of tax non-compliance.

In his article of political economy of tax reform, Evrenk (2009) provides an example in which a fully effective and costless reform targeting tax evasion is not supported by a majority of voters when only a minority evade, in this study with a different setup we find that under specific conditions none of the parties propose the reform targeting tax evasion.

CHAPTER THREE

METHODOLOGY

We model the situation as a game in which players are two purely office-motivated political parties. The objective of each party is to maximize their winning probabilities in a democratically held election. To this end we employ probabilistic voting theorem in which the probability of winning is a continuous function of the parties' electoral platforms. We find Nash equilibrium which is a solution concept of a non-cooperative game involving two or more players, in which each player is assumed to have the correct belief about the equilibrium strategies of the other player, and no player has anything to gain by changing only his own strategy. We employ a theoretical model and solve it analytically. Some of the issues encountered cannot be solved analytically, so for these we use Wolfram Research, Inc., Mathematica, Version 10.3, Champaign, IL (2015).

CHAPTER FOUR

THE MODEL

We consider a population that consists of two distinct income groups, high and low, $J \in \{H, L\}$. Everyone in group J has the same income Y_J , with $Y_H > Y_L$ The measure of population is normalized to unity and the population share of L is μ, so the population share of H is (1-μ). Low income individuals and some of the high income individuals cannot under report their income. But a fraction ρ of all high income individuals, i.e., (1-μ) ρ fraction of the whole population, can report their income as low and evade some part of the income tax if their expected payoff is greater under evasion. The government can audit and impose a fine to the caught evaders. Let Ω denote the probability that an evader will be audited and incurred a fine *F* (in addition to its real income tax). As the reader may note, when audited the evader will always be caught with probability one. In order to relate the fiscal dimension of policy with this probability, let the measure of audits is denoted by *A* and the cost of a single audit for government denoted by *c*. It is obvious that the government will not audit those who report high income. Since government has no information about who has low income and report low income or has high income but report low income, it will audit all the low income reporters with some probability. The probability of being audited for any evader is the ratio of the measure of audits over the measure of voters who report low income, i.e.,

$$\Omega = \frac{A}{\mu + (1-\mu)\rho}. \quad (4.1)$$

Each tax payer *i* has the same quasilinear preferences over his own private good consumption and general public good, represented by the utility function $U_i(C, G)$ where,

$$U_i(C_i, G) = C_i + lnG.$$

Government spending is financed by the income tax. Tax rate is flat e.g., τ and it satisfies $0 \leqslant \tau \leqslant 1$. Therefore for any individual in group *J* after tax income is (1-τ) Y_J . When there is no evasion, a situation we call clean (C), the utility levels of low and high income individuals are respectively,

$$U_L^C = (1-\tau)Y_L + lnG,$$

$$U_H^C = (1-\tau)Y_H + lnG.$$

When there is evasion, a situation we denote by (E), the expected utility of a high income voter who can (and, does) evade, denoted by $\tilde{H}$, and reporting his income as Y_L is,

$$E[U_{\tilde{H}}^E] = \Omega(Y_{\tilde{H}}(1-\tau) - F\tau(Y_{\tilde{H}} - Y_L)) + (1-\Omega)(Y_{\tilde{H}} - Y_L\tau) + lnG.$$

where *F* denotes the penalty rate he pays after paying his real income tax.

Since his utility when he does not evade is $U^C_{\tilde{H}} = (1-\tau)Y_{\tilde{H}} + lnG,$ high income voter who can evade will evade if and only if $E[U^E_{\tilde{H}}] > U^C_{\tilde{H}},$ i.e., if and only if,

$$\Omega(Y_{\tilde{H}}(1-\tau) - F\tau(Y_{\tilde{H}} - Y_L)) + (1-\Omega)(Y_{\tilde{H}} - Y_L\tau) + lnG > (1-\tau)Y_{\tilde{H}} + lnG.$$

Using (4.1), this can be rewritten as if and only if,

$$A < \frac{(\mu + (1-\mu)\rho)}{F+1} = A^*. \quad (4.2)$$

Proposition 1 *There are only two feasible value of number of audits A,i.e, A = 0 or A = A^*.*

If the measure of audits is lower than a threshold value ($A < A^*$) high income voters who can evade will certainly evade and since the probability of being audited and fined is low enough, their expected utility in evade (E) is greater than its utility in clean (C). Therefore, the government does not necessarily spend any amount for enforcement to prevent tax evasion, i.e, even if the government chooses a low level of enforcement which ensures that $A < A^*$, high income voters who can evade will still evade and enforcement policy will become irrelevant, namely this enforcement level cannot deter any tax evader from evading. So, in this case a rational government will set $A = 0$. And If the government wants to prevent tax evasion it will be sufficient for it to set $A = A^*$, i.e., high income voters who can evade will certainly not evade due to the fact that the probability of being audited and fined is too high that, their expected utility in evade (E) is less than its utility in clean (C). Since setting A higher than A^* cannot prevent more tax evasion it will become irrelevant and a rational government will choose A exactly equal to A^*.

Since the voters preferences over evasion are discrete i.e., they either evade o not-evade depending on the value of A, office-seeking political parties will propose a policy platform including either $A = 0$ (no enforcement) or $A = A^*$ (full enforcement) before the elections to win the majority of the votes.

There are two purely office-motivated political parties, P ∈ {A, B}, competing for office. Hence, parties announce their taxation policy, public good level policy and enforcement policy in order to maximize their chances of winning the election. We use probabilistic voting model. Therefore, in addition to economic policy, citizens care about non-economic issues. And political parties hold fixed and differentiated positions in some dimension other than economic policy. Winning corresponds to obtaining the support of more than half of the votes. And we assume that voting is costless and no voter abstains. At the time of the elections, voters base their voting decision both on the fiscal policy announcements of the candidates and the candidates' ideologies. Particularly, voter *i* in group *J* prefers candidate A if,

$$U_J(q_A) > U_J(q_B) + u^{iJ} + \delta.$$

Here, u^{iJ} is idiosyncratic parameter that can take on both negative and positive values. It measures voter *i* 's individual ideological bias toward candidate B. A positive value of u^{iJ} implies that voter *i* has a bias in favor of party B. We assume that this parameter has group-specific uniform distributions, e.g., $u^{iJ} \sim U[-\frac{1}{2\phi^J}, \frac{1}{2\phi^J}]$

These distributions have density ϕ_J which determines whether groups are ideology oriented or policy oriented. The higher the ϕ_J the more policy oriented the group is, i.e., ϕ_J can be thought of as a measure of the ideological perception of the voters in group *J*. If ϕ_J is large, then the distribution is focused around 0 and voters of group *J* are less strongly inclined towards one party so, the ideology plays a smaller role in their voting decision. If voters in group *J* can be more easily convinced to change their decision based on policy platforms, then voters in group *J* which has a larger ϕ_J have more influence on the policies. Namely, a small change in policies towards voters who have larger ϕ_J potentially yield more votes. In short, the value of ϕ_J is tantamount to political influence of the group *J*. Unlike u^{iJ}, δ is a common shock for all voters. It may represent popularity of candidates; it can also be positive or negative. Again we assume δ is uniformly distributed. e.g., $\delta \sim U\left[-\frac{1}{2\psi^J}, \frac{1}{2\psi^J}\right]$.

The timing of the game is as follows: (1) The two candidates, simultaneously and non-cooperatively, announce their electoral platforms: (q_A, q_B). At this stage, they know the voters' policy preferences. They also know the distributions for u^{iJ} and δ, but not yet their realized values, (2) the actual values of δ and u^{iJ} are realized and all uncertainty is resolved, (3) elections are held, (4) the elected candidate implements his announced policy platform.

Let us identify the "swing voter" who is indifferent between two parties:

$$u^J = U_J(q_A) - U_J(q_B) - \delta$$

All voters *i* in group *J* with $u^{iJ} \le u^J$ prefer party A to party B. The mass of voters in group *J* voting for party A can be calculated as:

$$\pi_A^J = [u^J - \frac{-1}{2\phi^J}]\phi_J = \frac{1}{2} + \phi_J u^J,$$

$$= \frac{1}{2} + \phi_J[U_J(q_A) - U_J(q_B) - \delta],$$

Since u^J depends on the realized value of δ

$$P_A = \underset{\delta}{\text{Prob}}[\sum_J \alpha_J \phi_J [U_J(q_A) - U_J(q_B)] \geqslant \delta \sum_J \alpha_J \phi_J].$$

It is easy to find the probability of an election victory by summing up votes across groups,

$$P_A = \underset{\delta}{\text{Prob}}[\pi_A \geqslant \frac{1}{2}] = \frac{1}{2} + \frac{\psi}{\sum_J \alpha_J \phi_J} \sum_J \alpha_J \phi_J [U_J(q_A) - U_J(q_B)].$$

Therefore, the winning probability of party A:

$$P_A = \frac{1}{2} + \frac{\psi(\mu\phi_L(U_{\text{LA}} - U_{\text{LB}}) + (1-\mu)\phi_H((1-\rho)(U_{\text{HA}} - U_{\text{HB}}) + \rho(U_{\tilde{H}A} - U_{\tilde{H}B})))}{\mu\phi_L + (1-\mu)\phi_H}. \qquad (4.3)$$

Note that, probability of winning is a continuous function of the parties' electoral platforms. Since winning the election means winning the largest share of votes, each party will try to maximize its expected vote share. And, since P_A and P_B are concave, there exist a unique solution (τ_P, G_P) to the maximization problem, and the game has a unique Nash Equilibrium where both parties propose the same policy. And this policy is a weighted sum of voter utility functions (Persson and Tabellini 2000:54). Namely, in unique equilibrium both candidates announce exactly the same platform.

Note that, P_B = 1 - P_A therefore both parties share the same maximization problem. While choosing policy platform each party takes the policy of the other party as given therefore each party maximizes something similar to social welfare function but with weights $\alpha_J\phi_J$ instead of α_J. The higher the ϕ_J the more homogeneous the group J is. The more homogeneous group the more votes party gets by tending its policy towards this group.

Using (4.3) and P_B = 1 - P_A, the winning probability of party B, can be written as:

$$P_B = \frac{1}{2} + \frac{\psi(\mu\phi_L(U_{\mathrm{LB}} - U_{\mathrm{LA}}) + (1-\mu)\phi_H((1-\rho)(U_{\mathrm{HB}} - U_{\mathrm{HA}}) + \rho(U_{\tilde{H}B} - U_{\tilde{H}A})))}{\mu\phi_L + (1-\mu)\phi_H}, \qquad (4.4)$$

CHAPTER FIVE

ANALYSIS OF NASH EQUILIBRIUM

In equilibrium each political party commits to a fiscal policy proposal that maximizes its chances of winning elections subject to the government's budget constraint, taking into account both citizen's expected voting decisions and its opponent's policy choice. Each citizen votes for the party that provides him with the maximum well-being given proposed economic policies, ideological biases, popularity shocks etc. Political parties maximize their vote shares based on the population share and political influence of voters, therefore in the simulations we examine the effects of μ (population share of low income voters), ρ (population share of high income voters who can evade), ϕ_J (group *J*'s political influence) and *F* (fine paid when caught by tax authority) to the equilibrium. Note that, political influence of low income voters is $\mu\phi_J$, political influence of high income voters who cannot evade is $(1-\mu)(1-\rho)\,\phi_J$ and political influence of high income voters who can evade is $(1-\mu)\rho\,\phi_J$.

There are two symmetric strategy profiles that are candidates for Nash equilibrium. The one in which there is no enforcement and the one in which there is full enforcement at the minimum cost. Therefore, possible policy platforms that a party (P) maximizes its expected vote share are as follows:

1. $q_P^{*E} = \left(\tau_P^{*E}, G_P^{*E}, A = 0; F(\text{irrelevant})\right)$

In this case, there is no spending for audit, which means that parties will announce no enforcement. Anyone who can evade will certainly evade. Since the government spending is financed by taxing the income, the government budget will be:

$$G_P^E = (\mu + (1-\mu)\rho)Y_L\tau_P^E + (1-\mu)(1-\rho)Y_H\tau_P^E. \qquad (5.5)$$

2. $q_P^{*C} = (\tau_P^{*C}, G_P^{*C}, A = A^*)$ with $F \leqslant \frac{Y_H(1-\tau)}{(Y_H-Y_L)\tau}$. Note that F has a constraint i.e., the expected income of an evader when audited and fined must be more than or equal to zero. i.e., $Y_H(1-\tau) - F(Y_H - Y_L) \geqslant 0$ implies $F \leqslant \frac{Y_H(1-\tau)}{(Y_H-Y_L)\tau}$ (bankruptcy condition).

In this case, there is audit and, any evader being audited is detected and made pay a fine. Therefore, political parties will announce full enforcement (big government). No one will evade. Collected taxes are available to be used by the elected party to produce a public good, *G* and to cover the cost of full enforcement. i.e., *Ac*. Then the government budget will be:

$$G_P^C = \mu Y_L\tau_P^C + (1-\mu)Y_H\tau_P^C - Ac. \qquad (5.6)$$

The first policy platform that a political party can choose includes A = 0. This time anyone who can evade will certainly evade and the utilities will be:

$$U_{\text{LP}}^{E} = (1-\tau_P^E)Y_L + lnG_P^E,$$

$$U_{\text{HP}}^{E} = (1-\tau_P^E)Y_H + lnG_P^E,$$

$$U_{\tilde{HP}}^{E} = Y_H - \tau_P^E Y_L + lnG_P^E,$$

where the government budget is:

$$G_P^E = (\mu + (1-\mu)\rho)Y_L\tau_P^E + (1-\mu)(1-\rho)Y_H\tau_P^E$$

The policy choice problem of party A in (E) is given by:

$$\max_{q_A^E} \; P_A^E(q_A^{*E}, q_B^{*E})$$

$$s.t.$$

$$G_A^E = (\mu + (1-\mu)\rho)Y_L\tau_A^E + (1-\mu)(1-\rho)Y_H\tau_A^E.$$

To characterize the equilibrium policy vector assume that party B has announced the equilibrium policy $q_B = q_B^*$. To find the equilibrium tax rate when there is no enforcement, differentiate P_A^E with respect to τ_A^E to obtain the FOC's.,

$$\frac{\partial P_A^E}{\partial \tau_A^E} = 0,$$

and using (5.5),

$$\tau_A^{*E} = \frac{-(-1+\mu)\phi_H + \mu\phi_L}{(-1+\mu)((-1+\rho)Y_H - \rho Y_L)\phi_H + \mu Y_L\phi_L}. \tag{5.7}$$

The second policy platform that a party can choose includes $A = A^*$. This time no one will evade and the utilities will be:

$$U_{\text{LP}}^{C} = (1-\tau_P^C)Y_L + lnG_P^C,$$

$$U_{\text{HP}}^{C} = (1-\tau_P^C)Y_H + lnG_P^C,$$

$$U_{\underset{\sim}{HP}}^{C} = (1 - \tau_P^C)Y_H + lnG_P^C,$$

where the government budget is:

$$G_P^C = \mu Y_L \tau_P^C + (1 - \mu)Y_H \tau_P^C - A^* c,$$

$$= \mu Y_L \tau_P^C + (1 - \mu)Y_H \tau_P^C - \frac{(\mu + (1 - \mu)\rho)}{F + 1} c$$

The policy choice problem of party A in (C) is given by:

$$\max_{q_A^E} \; P_A^C(q_A^{*C}, q_B^{*C})$$

$$s.t.$$

$$G_A^E = \mu Y_L \tau_A^C + (1 - \mu)Y_H \tau_A^C - \frac{(\mu + (1 - \mu)\rho)}{F + 1} c.$$

To find the equilibrium tax rate when there is full enforcement, differentiate P_A^C with respect to τ_A^C to obtain the FOC's.,

$$\frac{\partial P_A^C}{\partial \tau_A^C} = 0,$$

To analyze the equilibrium policy platforms, we impose several assumptions. First, we assume that the political influence of voters is proportional to their respective income. i.e., $\frac{\phi_H}{\phi_L} = \frac{Y_H}{Y_L} = k$ with $k > 1$. Then, the possible equilibrium policy platforms for party A can be written as:

$$\tau_A^{*C} = \frac{-2(1 + F)k(-1 + \mu)\mu + k^2(-1 + \mu)(-1 + F(-1 + \mu) + \mu - c\mu + c(-1 + \mu)\rho) + \mu(c\rho + \mu(1 + c + F - c\rho))}{(1 + F)(k(-1 + \mu) - \mu)(k^2(-1 + \mu) - \mu)Y_L} > 0. \quad (5.8)$$

$$G_A^{*C} = -\frac{(k + \mu - k\mu)^2}{k^2(-1 + \mu) - \mu} > 0. \quad (5.9)$$

$$\tau_A^{*E} = \frac{k + \mu - k\mu}{\big(\mu + k(-1+\mu)(k(-1+\rho) - \rho)\big)Y_L} > 0. \tag{5.10}$$

$$G_A^{*C} = -\frac{(k + \mu - k\mu)^2}{k^2(-1+\mu) - \mu} > 0. \tag{5.11}$$

Since the game is symmetric, the maximization problem of Party B is the same with party A, so are the equilibrium policies. Namely;

$$\tau_A^{*E} = \tau_B^{*E}, \tau_A^{*C} = \tau_B^{*C}, G_A^{*E} = G_B^{*E} \text{ and } G_A^{*C} = G_B^{*C}. \tag{5.12}$$

5.1 Analysis of equilibrium tax rates and public goods

Now that we have derived the candidates' symmetric equilibrium fiscal policy platforms (q_A^*, q_B^*), we can compare relative sizes of this policies in (E) and (C). First consider public good delivered in (E) and (C) respectively. The difference ΔG = $(G_P^{*E} - G_P^{*C})$ is given by,

$$= -\frac{(-1+k)^2(k(-1+\mu) - \mu)(-1+\mu)\mu\rho}{(k^2(-1+\mu) - \mu)(\mu + k^2(-1+\mu)(-1+\rho) + k(\rho - \mu\rho))}. \tag{5.11}$$

Proposition 2 *There is always more public good when some of the high income voters evade. i.e., $\Delta G > 0$,*

Proof: See Appendix A.

Recalling the government budgets in (E) and in (C), i.e., (5.5) and (5.6) respectively, it is clear that in (5.6) the government has an extra spending. And no matter how tax rates in (C) and in (E) changes relatively, public good delivered in (C) cannot be as high as the public good delivered in (E) due to this extra spending for full enforcement. In (E) the government spend all the budget (the revenue collected from income tax) to deliver public good. Whereas, in (C) the government has to spend some amount of collected tax revenue for enforcement to deter evaders from evading and the rest to deliver public good. Therefore, in this setup, due to the full enforcement policy in (C) public good delivered is always less than that in (E). Although, tax rates differ, i.e., tax rate in (C) might be greater than the tax rate in (E), still, due to the enforcement costs in (C) redistribution in (E) is greater than that in (C).

Second consider tax rates determined in (E) and (C) respectively. What we would like to determine is the behavior of τ_P^{*E} and τ_P^{*C} as functions of the parameters F, k, μ and ρ. Although it was easy to analyze public good levels analytically, analyzing tax rates is not as easy. For that reason, we use numerical simulations. But before examining the results in the simulations let us first consider the effect of the fine rate F to the equilibrium policies.

Lemma 1 *An increase in F decreases the equilibrium tax rate in (C) and does not affect the equilibrium tax rate in (E). An increase in c increases the equilibrium tax rate in (C) and does not affect the equilibrium tax rate in (E).*

Proof: Note that only τ_P^{*C} *depends on F and c. Therefore to see how* τ_P^{*C} *behaves in F and c, we differentiate* τ_P^{*C} *with respect to F and c respectively, finding that,*

$$\frac{\partial \tau_P^C}{\partial F} = \frac{c(\mu + \rho - \mu\rho)}{(1+F)^2(k(-1+\mu) - \mu)Y_L} < 0.$$

$$\frac{\partial \tau_P^C}{\partial c} = \frac{\mu(-1+\rho) - \rho}{(1+F)(k(-1+\mu) - \mu)Y_L} > 0.$$

for every possible value of the parameters. So as F increases, τ_P^{*C} *decreases, and as c increases* τ_P^{*C} *also increases. In both cases* τ_P^{*E} *does not change.* ■

To understand the intuition behind this result, recall that $G_P^C = \mu Y_L \tau_P^C + (1-\mu) Y_H \tau_P^C - \frac{(\mu+(1-\mu)\rho)}{F+1} c$. When *F* increases the term subtracted decreases, therefore the amount of public good can be provided with a lower tax rate. As a result, equilibrium tax rate decreases. Since the number of necessary audits ($A = \frac{(\mu+(1-\mu)\rho)}{F+1}$) decreases, a smaller government will be enough to deter voters from evading. Namely, the government needs to collect less income tax to prevent evasion. Therefore increasing *F* further, has no effect on τ_P^{*E} and decreases τ_P^{*C}.

When *c* increases the total cost of enforcement increases, therefore the government needs to collect higher income tax to fund enforcement. Therefore increasing c further, has no effect on τ_P^{*E} and increases τ_P^{*C} .

Now, let us consider the auditing procedure is costless, i.e., c = 0. τ_P^{*E} does not change and $\tau_P^{*C} = \frac{k+\mu-k\mu}{(-k^2(-1+\mu)+\mu)Y_L}$ which implies that $\tau_P^{*E} > \tau_P^{*C}$ and proposition 2 still holds, i.e., $G_P^{*E} > G_P^{*C}$. The tax rate and the public good level in (E) are always higher. Low income voters and evading high income voters drive these values up at the equilibrium.

Knowing the effects of F and c to the equilibrium tax rates, we keep F and c constant throughout the simulations and assume that F = 1 ($1 \leqslant \frac{Y_H(1-\tau)}{(Y_H-Y_L)\tau}$) and c = 1.

Let us first examine the equilibrium tax rates separately. To this end, observe the simulation results in Figure 1, when k, F, c and ρ are constant, as the population share of low income voters (μ) increases both τ_P^{*E}/Y_L and τ_P^{*C}/Y_L increases. Since Y_L is constant and positive τ_P^{*E} and τ_P^{*C} increases as well. The increase in μ means that one of the component of all high income voters e.g., (1-μ) decreases. So, the political influence of both high income voters decreases as well. And low income voters become more effective on political parties' decision. Therefore, the political parties choose their policy platform mostly based on the low income voters' preferences i.e., high tax rate and high public good level. So the political parties propose higher τ_P^{*E} and τ_P^{*C} as low income voters become more effective.

When all the parameters are constant but ρ increases; both τ_P^{*E} and τ_P^{*C} increases. But this time the increase rate of τ_P^{*E} is much higher than the increase rate of τ_P^{*C}. In this case the population share of evading high income voters increases and the population share of not-evading high income voters decreases respectively. Therefore, evading high income voters have more influence on the policy platform of the parties than not-evading high income voters do. Since evading high income voters will pay less income tax in (E) than they would pay in (C), these voters would like to share the wealth of the honest taxpayers. i.e., they would like to have more public services financed by mostly not-evading high income voters. In other words, they behave just as the low income voters do in terms of political platforms that they influence political parties. So, their influence in addition to the influence of low income voters force the parties to further increase the tax rate in (E). On the contrary in (C) these evading high income voters behave just as the other high income voters do. But, the tax rate is increasing slightly due to the enforcement policy of the parties. In other words, as ρ increases so does A^*. Therefore, the cost of the enforcement increases respectively and the parties propose higher tax rates to cover this cost.

Now consider the interval where ρ and μ decrease ((1-μ)(1-ρ) increases), namely the population share of not-evading high income voters increases, then both τ_P^{*E} and τ_P^{*C} decreases. This time not-evading high income voters have more influence on the parties' decision therefore parties will propose low income tax both in (E) and in (C) in order to win the majority of the votes. Since the honest rich people would not like to transfer their wealth to evaders as well as to low income voters, they force parties to lower their tax rate. Therefore, their influence brings the tax rate and public good down.

Finally when both ρ and μ increase, τ_P^{*E} and τ_P^{*C} also increase, but the increase in is τ_P^{*E} more than the increase in τ_P^{*C}. Since only the low income voters want higher tax rate in (C), and both evading high income voters and low income voters behave similarly in (E), and want higher tax rate, the political parties tilt their policy in the direction of increasing tax rate further. Therefore the increase in τ_P^{*E} will be more than the increase in τ_P^{*C}.

Figure 2 provides simulations measuring the effect of *k*. We choose the set of parameters that *k* can take. What we would like to determine is how the equilibrium tax rates in (E) and in (C) behaves relatively as *k* changes. To this end we examine the ratio of the tax rates i.e., $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ to make a relative comparison. And again by Lemma 1, we know that increasing *F* increases $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ for every possible values of parameters. Therefore, I've hold *F* constant at value 1 throughout the simulations (taking *F* equal to 1 is an assumption which is close to reality, in most countries *F* is equal to 1). Before going into the details of the simulation results note that, increasing *k* actually increases ϕ_H with respect to ϕ_L. So the political influence of low income voters decreases while the political influence of high income voters increases. Thus, the parties tilt their policy in the direction desired by high income voters. Intuitively, both low income voters and evading high income voters influence politicians to increase tax rate and not-evading high income voters influence politicians to decrease tax rate in (E). However only low income voters influence politicians to increase tax rate in (C).

First, consider Figure 2 panels a, b, c where $\mu < 1/2$ and keeping ρ constant at a relatively low level, when *k* increases, $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ stays constant but as μ increases the value of $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ decreases. Recall that as μ increases both tax rates increase. But since $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ decreases τ_P^{*C} must have increased more than τ_P^{*E}. Due to the cost of full enforcement in (C), parties have to propose higher tax rate than they propose in (E) in order to provide the same level of total utility to the most influential group (in this case, low income voters) in both (E) and (C). Therefore, $\frac{\tau_P^{*E}}{\tau_P^{*C}} < 1$ i.e., $\tau_P^{*E} > \tau_P^{*C}$ and, τ_P^{*C} increases more than τ_P^{*E}. Since *k* is the ratio of the group specific political influences, as *k* increases the low income voters' ability to influence equilibrium policies decreases. In other words, the higher the value of *k* the lower the influence of the low income voters to the equilibrium. i.e., the high values of *k* alongside with the low values of μ, make the low income voters' influence become almost negligible at the equilibrium fiscal policies of the parties. Only high income voters become effective at the equilibrium therefore keeping ρ constant and increasing *k* further increases the group specific political influence of high income voters which does not change the equilibrium (there are no other groups, except for the high income voters, who can effect equilibrium policies) so, $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ becomes constant.

Keeping all parameters constant and increasing only ρ, increases the evading high income voters' influence at the equilibrium. Although their influence increases both τ_P^{*E} and τ_P^{*C}, τ_P^{*E} increases more than τ_P^{*C}. Therefore $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ increases, and $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ becomes greater than 1, i.e.,. $\tau_P^{*E} > \tau_P^{*C}$ ($\frac{\tau_P^{*E}}{\tau_P^{*C}} > 1$). Namely, high income evaders behave like low income voters in (E) and higher level of both τ_P^{*E} and G_P^{*E} is what they prefer and are offered.

Now consider Figure 2 panels d, e, f where $\mu > 1/2$, and again keeping ρ constant at a relatively low level, while k increases, initially $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ decreases but, when k is getting higher and higher, $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ becomes constant. To understand the intuition behind this, first recall that in the model overall political influence of a group of voters has two components. One is their population share α_J and the other is their group specific political influence ϕ_J. When k is small initially and $\mu > 1/2$ the low income voters are effective at the equilibrium due to the high population share and relatively high group specific political influence. In this case, they want high tax rate and high level of public good both in (C) and in (E). But as k increases, their influence decreases both in (C) and in (E). With the lack of the influence of the low income voters, the tax rate both in (C) and in (E) decreases respectively. But looking carefully the decrease in τ_P^{*E} is more than that in τ_P^{*C}. Because, in (C) the government's budget constraint includes full enforcement cost. And recall (4.1), as the low income voters' population share increases so does the measurement of audit and the total cost of enforcement. Therefore, to cover the increasing cost of enforcement, parties have to propose high τ_P^{*E} in (C). And, recall the government budget constraint in (5.6), i.e., $G_P^C = \mu Y_L \tau_P^C + (1-\mu) Y_H \tau_P^C - Ac \geqslant 0$, 0, $\tau_P^C \geqslant \frac{Ac}{\mu Y_L + (1-\mu) Y_H}$. Therefore τ_P^C can not fall below a certain positive value. As for τ_P^E, it can be either equal to or greater than zero, i.e., $\tau_P^E \geqslant$

Finally, consider the interval where ρ and μ decreases ((1-μ) (1-ρ) increases), namely the population share of not-evading high income voters increases, then both τ_P^C and τ_P^C decreases as expected. As it is seen in the Figure 2 panel c, $\frac{\tau_P^{*E}}{\tau_P^{*C}} < 1$, i.e., $\tau_P^{*E} < \tau_P^{*C}$. Recall that τ_P^{*E} cannot fall below a certain level due to the full enforcement policy in (C). Although not-evading high income voters would not like to transfer their wealth to evaders as well as to low income voters in (E), since the equilibrium tax rate proposed in (E) is lower than that in (C) and the public good proposed in (E) is more than that in (C), they might choose (E) rather than (C) based on the utilities in (C) and in (E), i.e., they choose whichever is high. To understand this, we have to find Nash equilibrium policy platforms. Next section deals with Pure Strategy Nash Equilibrium. (PSNE)

5.2 Equilibrium

In equilibrium each party chooses a tax rate that maximizes voters' welfare weighted by their political influence given the enforcement policy it proposes. In other words, in equilibrium each party chooses a fiscal policy that gives the electorate highest weighted utility conditional on the enforcement it proposes. Intuitively, for a given enforcement level, the tax rate and public good level enters into a party's objective function only through the probability of winning the election. Therefore, for a given level of enforcement, the politician maximizes this probability (and, thus, the voters' weighted utility). As a result we have two possible strategy profiles that parties can choose as a best response to each other's policy platform i.e., party A can either choose $q_A^{*E}{}_{=}(\tau_A^{*E}, G_A^{*E}, A = 0)$ or $q_A^{*C}{}_{=}(\tau_A^{*C}, G_A^{*C}, A = A^*)$. And since the game is symmetric party B can either choose $q_B^{*E}{}_{=}(\tau_B^{*E}, G_B^{*E}, A = 0)$ or $q_A^{*C}{}_{=}(\tau_B^{*C}, G_B^{*C}, A = A^*)$.

To find the equilibrium strategies let us first assume that (q_A^{*E}, q_B^{*E}) is the equilibrium strategy profile i.e., party A chooses $q_A^{*E}{}_{=}(\tau_A^{*E}, G_A^{*E}, A = 0)$ and party B chooses $q_B^{*E}{}_{=}(\tau_B^{*E}, G_B^{*E}, A = 0)$ as a best response to each other. Therefore, if (q_A^{*E}, q_B^{*E}) is an equilibrium policy vector then any deviation from this strategy profile must not be profitable for the deviating party. To see this, again assume that party A sticks to its equilibrium policy platform e.g. $q_A^{*E}{}_{=}(\tau_A^{*E}, G_A^{*E}, A = 0)$ and party B deviates from its equilibrium policy platform $q_B^{*E}{}_{=}(\tau_B^{*E}, G_B^{*E}, A = 0)$ to another possible policy platform $q_A^{*C}{}_{=}(\tau_B^{*C}, G_B^{*C}, A = A^*)$. Since party A sticks to (E) (no enforcement at all i.e., A = 0), public good delivered by party A and utilities of the voters become:

$$G_A^{*E} = (\mu + (1-\mu)\rho)\tau_A^{*E} Y_L + (1-\mu)(1-\rho)\tau_A^{*E} Y_H;$$

$$U_{\text{LA}}^E = (1 - \tau_A^{*E})Y_L + lnG_A^{*E};$$

$$U_{\text{HA}}^E = (1 - \tau_A^{*E})Y_H + lnG_A^{*E};$$

$$U_{\underset{\sim}{HA}}^E = Y_H - \tau_A^{*E} Y_L + lnG_A^{*E};$$

Since party B deviates to (C) (full enforcement i.e., $A = A^*$), public good delivered by party B and utilities of the voters become:

$$G_B^{*C} = \mu\tau_B^{*C} Y_L + (1-\mu)\tau_B^{*C} Y_H - A^* c;$$

$$U_{\text{LB}}^C = (1 - \tau_B^{*C})Y_L + lnG_B^{*C};$$

$$U_{\text{HB}}^C = (1 - \tau_B^{*C})Y_H + lnG_B^{*C};$$

$$U_{\underset{\sim}{HB}}^C = (1 - \tau_B^{*C})Y_H + lnG_B^{*C}$$

Note that if (q_A^{*E}, q_B^{*E}) is equilibrium, because of the symmetry in the game the winning probabilities of parties are the same and equal to 1/2. And, recall that the winning probability of party B, when party A chooses q_A^{*E} and party B chooses q_B^{*C} is:

$$P_B^C = \frac{1}{2} + \frac{\psi(\mu\phi_L(U_{\text{LB}}^C - U_{\text{LA}}^E) + (1-\mu)\phi_H((1-\rho)(U_{\text{HB}}^C - U_{\text{HA}}^E) + \rho(U_{\underset{\sim}{HB}}^C - U_{\underset{\sim}{HA}}^E)))}{\mu\phi_L + (1-\mu)\phi_H}$$

ψ > 0 and let,

$$\Delta P_B^C = \frac{\mu\phi_L(U_{\text{LB}}^C - U_{\text{LA}}^E) + (1-\mu)\phi_H((1-\rho)(U_{\text{HB}}^C - U_{\text{HA}}^E) + \rho(U_{\tilde{HB}}^C - U_{\tilde{HA}}^E))}{\mu\phi_L + (1-\mu)\phi_H}. \quad (5.12)$$

$$P_B^C = \frac{1}{2} + \psi \Delta P_B^C.$$

Note that, the policy platform (q_A^{*E}, q_B^{*E}) is a Nash equilibrium if and only if $\Delta P_B^C < 0$. So, based on the value of ΔP_B^C we can determine Nash equilibrium policies. Using (5.8) through (5.12) and (5.14), one can show that ΔP_B^C is equal to,

$$-\frac{c(k^2(-1+\mu)-\mu)(\mu(-1+\rho)-\rho) + (1+F)(k+\mu-k\mu)^2 ln\left[\frac{G_A^{*E}}{G_A^{*C}}\right]}{(1+F)(k+\mu-k\mu)^2}. \quad (5.13)$$

Now, assume that (q_A^{*C}, q_B^{*C}) is the equilibrium strategy profile i.e., party A chooses $q_A^{*C}{}_=(\tau_A^{*C}, G_A^{*C}, A = A^*)$ and party B chooses $q_B^{*C}{}_=(\tau_B^{*C}, G_B^{*C}, A = A^*)$ as a best response. Therefore, if (q_A^{*C}, q_B^{*C}) is equilibrium policy vector then any deviation from this strategy must not be profitable for each of the parties. To see this, again assume that party A sticks to its' equilibrium policy e.g. $q_A^{*C}{}_=(\tau_A^{*C}, G_A^{*C}, A = A^*)$ and party B deviates from its' equilibrium policy $q_B^{*C}{}_=(\tau_B^{*C}, G_B^{*C}, A = A^*)$ to another possible policy platform $q_B^{*E}{}_=(\tau_B^{*E}, G_B^{*E}, A = 0)$.

Since party A sticks to (C), public good delivered by party A and utilities of the voters will be:

$$G_A^{*E} = \mu\tau_A^{*C}Y_L + (1-\mu)\tau_A^{*C}Y_H - A^*c;$$

$$U_{\text{LA}}^C = (1-\tau_A^{*C})Y_L + lnG_A^{*C};$$

$$U_{\text{HA}}^C = (1-\tau_A^{*C})Y_H + lnG_A^{*C};$$

$$U^{C}_{\tilde{H}A} = (1-\tau^{*C}_{A})Y_H + lnG^{*C}_{A};$$

and if party B switches to (E), public good delivered by party B and utilities of the voters will be:

$$G^{*E}_{B} = (\mu + (1-\mu)\rho)\tau^{*E}_{B}Y_L + (1-\mu)(1-\rho)\tau^{*E}_{B}Y_H;$$

$$U^{E}_{\mathrm{LB}} = (1-\tau^{*E}_{B})Y_L + lnG^{*E}_{B};$$

$$U^{E}_{\mathrm{HB}} = (1-\tau^{*E}_{B})Y_H + lnG^{*E}_{B};$$

$$U^{E}_{\tilde{H}B} = Y_H - \tau^{*E}_{B}Y_L + lnG^{*E}_{B};$$

The winning probability of party B when party A chooses q^{*C}_{A} and party B chooses q^{*E}_{B} is:

$$P^{C}_{B} = \frac{1}{2} + \frac{\psi(\mu\phi_L(U^{C}_{\mathrm{LB}} - U^{E}_{\mathrm{LA}}) + (1-\mu)\phi_H((1-\rho)(U^{C}_{\mathrm{HB}} - U^{E}_{\mathrm{HA}}) + \rho(U^{C}_{\tilde{H}B} - U^{E}_{\tilde{H}A})))}{\mu\phi_L + (1-\mu)\phi_H}$$

$\psi > 0$ and let,

$$\Delta \mathrm{P}^{E}_{B} = \frac{\mu\phi_L(U^{E}_{\mathrm{LB}} - U^{C}_{\mathrm{LA}}) + (1-\mu)\phi_H((1-\rho)(U^{E}_{\mathrm{HB}} - U^{C}_{\mathrm{HA}}) + \rho(U^{E}_{\tilde{H}B} - U^{C}_{\tilde{H}A}))}{\mu\phi_L + (1-\mu)\phi_H}, \quad (5.14)$$

$$P^{E}_{B} = \frac{1}{2} + \psi\Delta \mathrm{P}^{E}_{B}.$$

The policy platform (q^{*C}_{A}, q^{*C}_{B}) is Nash equilibrium if and only if $\Delta \mathrm{P}^{E}_{B} < 0$.

And again Using (5.8) through (5.12) and (5.16), one can show that $\Delta \mathrm{P}^{E}_{B}$ is equal to,

$$\frac{c(k^2(-1+\mu)-\mu)(\mu(-1+\rho)-\rho) + (1+F)(k+\mu-k\mu)^2 ln\left[\frac{G^{*E}_{A}}{G^{*C}_{A}}\right]}{(1+F)(k+\mu-k\mu)^2} \quad (5.15)$$

Comparing (5.14) with (5.15), it can be shown that $\Delta P^{E}_{B} = -\Delta \mathrm{P}^{C}_{B}$.

Lemma 2 *Since* $\Delta P_B^E = -\Delta P_B^C$, *the game has a unique Nash Equilibrium.*

Proof : Assume that (q_A^{*C}, q_B^{*C}) *is a Nash equilibrium, i.e.,* $\Delta P_B^E < 0$ *then* $\Delta P_B^C > 0$, *therefore* (q_A^{*E}, q_B^{*E}) *can not be a Nash Equilibrium at the same time. And now assume that* (q_A^{*E}, q_B^{*E}) *is a Nash equilibrium, i.e.,* $\Delta P_B^C < 0$ *then* $\Delta P_B^E > 0$, *therefore* (q_A^{*C}, q_B^{*C}) *cannot be a Nash Equilibrium at the same time. Finally, assume that* (q_A^{*E}, q_B^{*C}) *is a Nash equilibrium. Since* $\Delta P_B^E = -\Delta P_B^C$, *for one of the parties must be profitable to deviate from the equilibrium policy and because of this,* (q_A^{*E}, q_B^{*C}) *cannot be a Nash equilibrium. And, by the same token and the symmetry in the game,* (q_A^{*C}, q_B^{*E}) *cannot be an equilibrium policy as well. Therefore, the Nash equilibrium must be unique.* ■

Proposition 3 *For every possible value of k, μ, ρ and F (* $k > 1$, $0 < \mu < 1$, $0 < \rho < 1$, $c > 0$ *and* $F > 0$*)* , $\Delta P_B^C < 0$. *Therefore, the unique P.S.N.E. of the game is* (q_A^{*E}, q_B^{*E}).

Proof: See Appendix A.

Since $\Delta P_B^C < 0$ for all possible values of parameters and $\Delta P_B^E = -\Delta P_B^C$, $\Delta P_B^E > 0$ for all possible values of parameters. So party B (and, since the argument is symmetric party A as well) will find it not profitable to deviate from a strategy profile in which the other party is proposing no enforcement. Since no party is better off from deviating, there is equilibrium in which both parties proposes no enforcement. And party B (and, since the argument is symmetric party A as well) will find it profitable to deviate from a strategy profile in which the other party is proposing enforcement to prevent evasion. Since each party is better off from deviating there is no equilibrium in which a party proposes any level of enforcement. Therefore tax evasion by those who can evade will be the unique equilibrium outcome (q_A^{*E}, q_B^{*E}).*i.e.*, $q_A^{*E} {}_{=} (\tau_A^{*E}, G_A^{*E}, A = 0)$ and $q_B^{*E} {}_{=} (\tau_B^{*E}, G_B^{*E}; A = 0)$ where $\tau_A^{*E} = \tau_B^{*E}$, $\tau_A^{*C} = \tau_B^{*E}$ and $G_A^{*E} = G_B^{*E}$, $G_A^{*C} = G_B^{*C}$ is the equilibrium strategy profile of the political parties.

Thus far we assume that parties may propose either no enforcement or full enforcement. But in real world this is highly unlikely. In fact, the country might already have got an inefficient fiscal policy. i.e., an enforcement policy which does not prevent evasion and anyone who can evade certainly evades. Therefore, when a party comes to power it has to undertake existing enforcement policy i.e., they cannot fire employees or reduces the expenses already exist. But, they can maintain the same level of existing enforcement policy without increasing the cost of enforcement just by not hiring new employees or allocating new resources. In this case a party will propose either no enhancements to the existing enforcement policy and allow evasion or propose enhancement to the existing enforcement policy to prevent evasion which we called full enforcement previously. Let us denote the audit measure as A' when enforcement policy is ineffective. To allow evasion A' must be between 0 and A^*. i.e, $0 < A' < A^*$.

Proposition 4 *For any enforcement level less than full enforcement level and more than no enforcement level, the unique P.S.N.E. of the game does not change and is* (q_A^{*E}, q_B^{*E}).

Proof: See Appendix A.

The public good delivered does not change but equilibrium tax rates do. And for all values of the parameters;

$$G_A^{*E} > G_A^{*C}$$

$$\tau_A^{*E} > \tau_A^{*C}$$

Because of the high level of tax rates in (E) increasing A' to the level of A^* does not change the equilibrium.

We find that some of the high income taxpayers evading is the unique Nash Equilibrium outcome. Since evading high income voters and low income voters behave similarly in (E), they prefer (E) due to the high level of public good in (E). Surprisingly, even if not-evading high income voters are more effective, the equilibrium does not change. Too assess the intuition behind this result, recall that the winning probability function of the parties comprised of voters' weighted utility differences. Although rich evaders prefer (C) to (E) in ideal circumstances since, all high income voters weighted utility in E outweighs that in (C), they also prefer (E) to (C) in our set up. Namely, policy in (C), hurts evading high income voters via auditing policy and works in favor of not-evading high income voters and policy in (E) hurts not evading high income voters and works in favor of evading high income voters so that they can under report. Since government needs to allocate more resources to prevent tax payers in (C) than the favor not evading high income voters obtain in (C), (E) becomes the best response for all parts.

CHAPTER SIX

CONCLUSION

We study the effectiveness of tax reform using probabilistic voting. In the model we study, political competition is between two groups of politicians who may differ from each other in some aspects. The voters value not only a party's fiscal policy, but also his other characteristics.

We find that the tax reform is not supported by the voters. That is, tax evasion by those who can evade will be the unique equilibrium outcome. As a summary, in the setup we study, enforcement is never a favorable policy.

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APPENDIX A

A.1. Proof of proposition 2 i.e., ΔG > 0 for all possible values of μ, ρ, *F* and k e.g., 0 < μ < 1, 0 < ρ < 1, *k* > 1 and F irrelevant,

$$(-1+k)^2(k(-1+\mu)-\mu)(-1+\mu)\mu\rho > 0 \; and,$$

$$(k^2(-1+\mu)-\mu)\big(\mu+k^2(-1+\mu)(-1+\rho)+k(\rho-\mu\rho)\big) < 0,$$

Therefore, $\frac{(-1+k)^2(k(-1+\mu)-\mu)(-1+\mu)\mu\rho}{(k^2(-1+\mu)-\mu)(\mu+k^2(-1+\mu)(-1+\rho)+k(\rho-\mu\rho))} < 0$ which implies that;

$\Delta \mathrm{G} = -\frac{(-1+k)^2(k(-1+\mu)-\mu)(-1+\mu)\mu\rho}{(k^2(-1+\mu)-\mu)\big(\mu+k^2(-1+\mu)(-1+\rho)+k(\rho-\mu\rho)\big)} > 0$ i.e., $G_A^{*E} > G_A^{*C}$. ■

A.2. Proof of proposition 3, $\Delta \mathrm{P}_B^C < 0$ where *k* > 1, 0 < μ < 1, 0 < ρ < 1 and *F* > 0 and c > 0.

$c(k^2(-1+\mu)-\mu)(\mu(-1+\rho)-\rho) > 0$ and

from proposition 2, $\frac{G_A^{*E}}{G_A^{*C}} > 1$ which implies, $ln\,[\frac{G_A^{*E}}{G_A^{*C}}] > 0$,

$$(1+F)(k+\mu-k\mu)^2 ln\left[\frac{G_A^{*C}}{G_A^{*E}}\right] > 0$$

$$k^2(-1+\mu)-\mu)(\mu(-1+\rho)-\rho)+(1+F)(k+\mu-k\mu)^2 ln[\frac{G_A^{*C}}{G_A^{*E}}] > 0,$$

And since $(1+F)(k+\mu-k\mu)^2 > 0$,

$$\Delta \mathrm{P}_B^C = -\frac{k^2(-1+\mu)-\mu)\mu(-1+\rho)-\rho)-(1+F)(k+\mu-k\mu)^2 \ln[\frac{G_A^{*C}}{G_A^{*E}}]}{(1+F)(k+\mu-k\mu)^2} < 0.\ ■$$

A.3. Proof of proposition 4; For any A, 0 < A < A^*, the unique P.S.N.E. of the game does not change.

Note that when A' = 0, we already know that (q_A^{*E}, q_B^{*E}) is equilibrium policies. As A' increases this equilibrium might change. To see whether the equilibrium policies changes or not let;

$$A' = (A^* - \epsilon) \text{ where } \epsilon > 0 \text{ and infinitely small.}$$

Thus, public good delivered by party A and utilities of the voters become:

$$G_A^{*E} = (\mu + (1-\mu)\rho)\tau_A^{*E} Y_L + (1-\mu)(1-\rho)\tau_A^{*E} Y_H - (A^* - \epsilon)c;$$

$$U_{\mathrm{LA}}^E = (1 - \tau_A^{*E})Y_L + lnG_A^{*E};$$

$$U_{\mathrm{HA}}^E = (1 - \tau_A^{*E})Y_H + lnG_A^{*E};$$

$$U_{\underset{HA}{\sim}}^E = Y_H - \tau_A^{*E} Y_L + lnG_A^{*E};$$

Since party B deviates to (C) (full enforcement i.e.,A = A^*), public good delivered by party B and utilities of the voters become:

$$G_B^{*C} = \mu\tau_B^{*C} Y_L + (1-\mu)\tau_B^{*C} Y_H - A^* c;$$

$$U_{\mathrm{LB}}^C = (1 - \tau_B^{*C})Y_L + lnG_B^{*C};$$

$$U_{\mathrm{HB}}^C = (1 - \tau_B^{*C})Y_H + lnG_B^{*C};$$

$$U_{\underset{HB}{\sim}}^C = (1 - \tau_B^{*C})Y_H + lnG_B^{*C}$$

Note that if (q_A^{*E}, q_B^{*E}) is equilibrium, because of the symmetry in the game the winning probabilities of parties are the same and equal to 1/2. And, recall that the winning probability of party B, when party A chooses q_A^{*E} and party B chooses q_B^{*C} is:

$$P_B^C = \frac{1}{2} + \frac{\psi(\mu\phi_L(U_{\mathrm{LB}}^C - U_{\mathrm{LA}}^E) + (1-\mu)\phi_H((1-\rho)(U_{\mathrm{HB}}^C - U_{\mathrm{HA}}^E) + \rho(U_{\tilde{HB}}^C - U_{\tilde{HA}}^E)))}{\mu\phi_L + (1-\mu)\phi_H}$$

ψ > 0 and let,

$$\Delta \mathrm{P}_B^C = \frac{\mu\phi_L(U_{\mathrm{LB}}^C - U_{\mathrm{LA}}^E) + (1-\mu)\phi_H((1-\rho)(U_{\mathrm{HB}}^C - U_{\mathrm{HA}}^E) + \rho(U_{\tilde{HB}}^C - U_{\tilde{HA}}^E))}{\mu\phi_L + (1-\mu)\phi_H}.$$

$$P_B^C = \frac{1}{2} + \psi\Delta \mathrm{P}_B^C.$$

Note that, the policy platform (q_A^{*E}, q_B^{*E}) is a Nash equilibrium if and only if $\Delta \mathrm{P}_B^C < 0$.

So, based on the value of $\Delta \mathrm{P}_B^C$ we can determine Nash equilibrium policies. It can be shown that $\Delta \mathrm{P}_B^C$ is equal to,

$$(k^3(c\epsilon + X(-1+\mu))(-1+\mu)^2(-1+\rho) + k(-1+\mu)\mu(X(3\mu(-1+\rho) - 2\rho) + c(\epsilon - 2A\rho + \epsilon\rho)) + \mu(-c(\epsilon\mu - A(-1+\mu)\rho) + X\mu(\mu + \rho - \mu\rho)) - k^2(-1+\mu)(X(-1+\mu)(3\mu(-1+\rho) - \rho) - c(A\mu\rho + \epsilon(\mu + \rho - 2\mu\rho))))/\left((k + \mu - k\mu)^2(\mu + k(-1+\mu)(-1+\rho) + \rho - \mu\rho)\right).$$

where $X = ln\,[\frac{G_A^{*C}}{G_A^{*E}}] < 0$, $k > 1$, $0 < \mu < 1$, $0 < \rho < 1$, $F > 0$ and $c > 0$.

By dividing equation into parts the numerator of the equation can be re-written as:

1. $k^3(c\epsilon + X(-1+\mu))(-1+\mu)^2(-1+\rho) < 0$
2. $k(-1+\mu)\mu(X(3\mu(-1+\rho) - 2\rho) + c(\epsilon - 2A\rho + \epsilon\rho)) < 0$
3. $\mu(-c(\epsilon\mu - A(-1+\mu)\rho) + X\mu(\mu + \rho - \mu\rho)) < 0$
4. $-k^2(-1+\mu)(X(-1+\mu)(3\mu(-1+\rho) - \rho) - c(A\mu\rho + \epsilon(\mu + \rho - 2\mu\rho))) < 0$

Adding up 1 thorough 4 the sign of the numerator is negative.

And the sign of the denominator is positive. i.e,

$$(\mu + k(-1+\mu)(-1+\rho) + \rho - \mu\rho) > 0$$

Which concludes that the sign of ΔP_B^C is negative. i.e.,

$$\Delta P_B^C < 0.$$

By the same token one can show that;

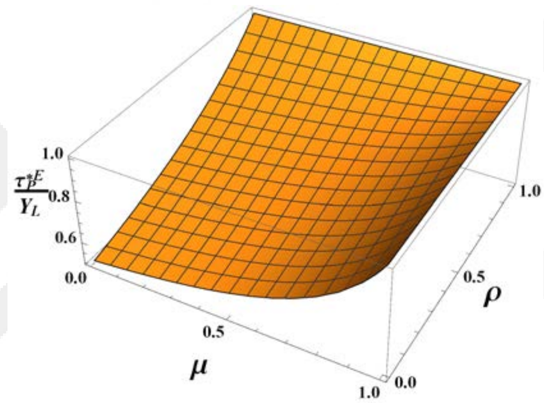
$$\Delta P_B^E > 0.$$

So party B (and, since the argument is symmetric party A as well) will find it not profitable to deviate from a strategy profile in which the other party is proposing no enhancement for the existing enforcement policy. Since no party is better off from deviating, there is equilibrium in which both parties proposes no enhancement for the existing enforcement policy. And party B (and, since the argument is symmetric party A as well) will find it profitable to deviate from a strategy profile in which the other party is proposing full enforcement to prevent evasion. Since each party is better off from deviating there is no equilibrium in which a party proposes full enforcement. Therefore, tax evasion by those who can evade will be the unique equilibrium outcome.

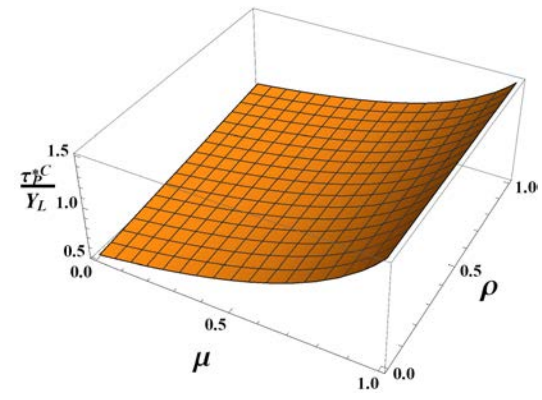
i.e., the unique P.S.N.E. of the game is still (q_A^{*E}, q_B^{*E}). ■

APPENDIX B

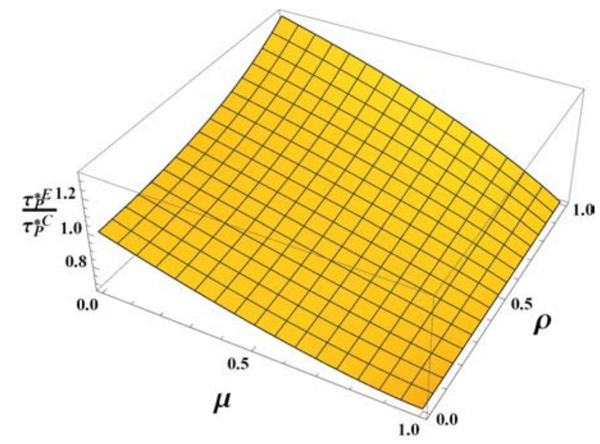
Figure1. How τ_P^{*E} and τ_P^{*C} changes in μ and ρ when $F = 1, c = 1$ and $k = 2$



(1. a)



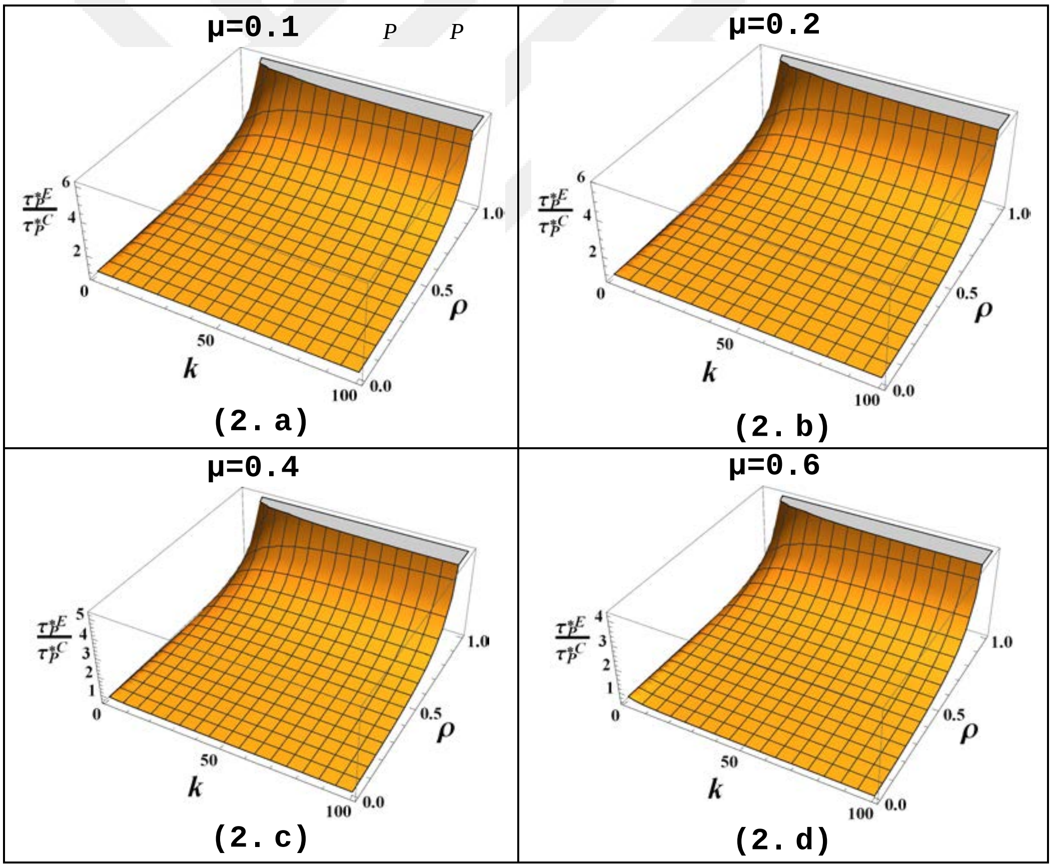
(1. b)

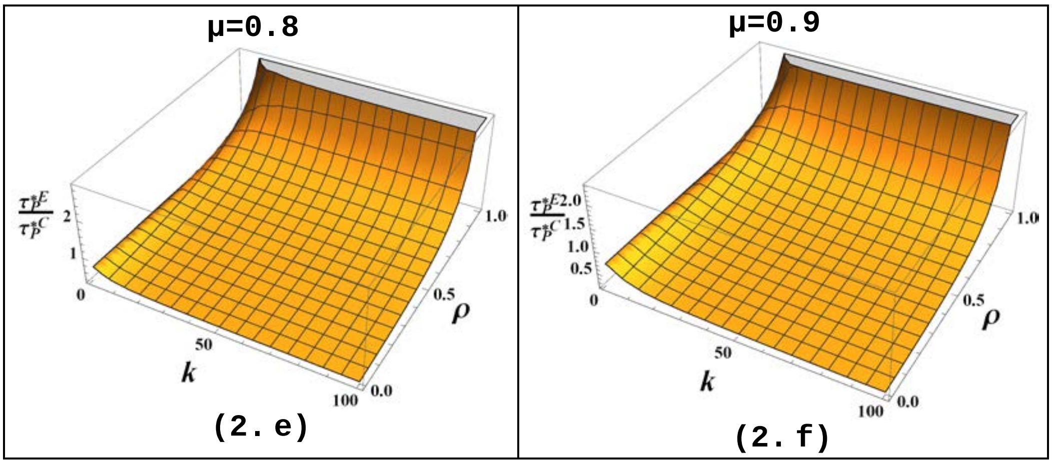


(1. c)

APPENDIX C

Figure1. How $\frac{\tau_P^{*E}}{\tau_P^{*C}}$ changes in μ, ρ and k when $F = 1$ and $c = 1$.




μ=0.8
μ=0.9
(2. e)
(2. f)
k
ρ