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POLITICAL OPTIMAL TAX POLICY MAKING IN A PROBABILISTIC VOTING FRAMEWORK

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Tax policy in democratic societies can best be understood as the equilibrium outcome of a political process that trades off economic and political forces within a given set of institutions. We use a probabilistic voting framework to analyze the structure of tax policy in political equilibrium. Among available models, the probabilistic voting or expected vote maximization model appears well suited to deal with tax structure in a democratic setting. In particular, we apply the probabilistic voting model to tax policy making, focusing on analyzing the outcome of vote maximization.

We aim to characterize the political equilibrium tax structure, and interpret that equilibrium in a probabilistic voting framework. In addition, we incorporate tax illusion in the probabilistic voting model in which voters perceive candidate's tax policy to be inaccurate, and examine the effect of voter's tax illusion on the political costs.

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Ⅰ. INTRODUCTION

During the last two decades, we have learned about the implications of candidates having uncertainty about voters' choices. Substantial progress has been made on understanding the relation between candidate uncertainty and electoral equilibrium. In addition, interesting applications of probabilistic voting model to

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tax policy have been topics of interest in the taxation theory. In particular, probabilistic voting model has provided us to get more insight into the nature of electoral competition and tax structure. Probabilistic voting models are now established as important instruments for analyzing elections, party competition and positive tax structure.

Spatial voting theorists have become interested in the implications of candidate uncertainty about voters' choices because there are some empirical reasons for believing that actual candidates often are uncertain about the choices that voters will make on election day. First, candidates tend to rely on polls for information about how voters will vote in the next election, but information from public opinion surveys has often errors. Second, even when economists and political scientists have developed sophisticated statistical models of voters' choices and have used appropriate data sets to estimate them, there has consistently been a residual amount of 'unexplained variation'. Thus, public choice scholars have adopted and developed the models in which candidates are assumed to have probabilistic, rather than deterministic, expectations about voters' choices.

Tax policy in democratic societies can best be understood as the equilibrium outcome of a political process that trades off economic and political forces within a given set of institutions. There are six well-known models to deal with the political economy of taxation: the median voter model, the structure-induced equilibrium model, the probabilistic voting model, the Leviathan model, the cooperative game theory and the representative agent model. Among them, probabilistic voting model is more appropriate for the study of complex tax systems than any of the alternatives. Two key features of the probabilistic voting model lie in the capacity to deal with multidimensional policy spaces and in the fact that the model captures well the idea that equilibrium policy trades off many opposing voter interests.

Hettich and Winer(1988) argue that the essential stylized facts of observed tax systems can be seen as the outcome of optimizing economic and political behaviors, and the evolution of tax systems can be viewed as a sequence of responses to changing economic, administrative and political factors. Moreover, Hettich and Winer(1997) claim that tax policies can be seen as equilibrium outcomes of a collective choice process that is constrained by political as well as economic forces, and we believe that tax analysis at its best should reflect this more inclusive and complex view of the fiscal process.

The politics of taxation can best be analyzed using the 'probabilistic voting model' because it implies that elected representatives take account of *all* voters' interests, not simply those of voters who voted for them, or that of the *marginal* voter. In addition, the probabilistic voting model is proved to be robust to electoral circumstances in that it has equilibrium in a multiple policy dimension and voter preference settings. Applying that model to taxation yields some provocative result under the assumption of no administration costs that the politically ideal tax system is enormously *complex*. In such a limiting case, every type of voter will be taxed at a different rate and face a different tax base. The other property of the probabilistic voting model is that the policies adopted tend to be *Pareto efficient*. In a probabilistic voting model, political competition tends to force parties to adopt Pareto efficient policies. In effect, the expected vote function is a specific form of a utilitarian social welfare function, and competition between candidates assures that the 'electoral' (i.e., politically weighted) social welfare function is maximized.

The approach to political economy adopted in Hettich and Winer model (1988,1997) focuses on the modeling of 'political equilibrium' rather than of the political process.[1] That is, they characterize the political equilibrium of the tax policy, and interpret the political equilibrium. In addition, we attempt to incorporate the 'tax illusion' by voters into the probabilistic voting model and examine the effect of tax illusion on the political costs. We expect that underestimated tax illusion of voters serves to *constrain* the political optimal tax policy in that it may increase political costs further.

In section Ⅱ, we introduce a general probabilistic voting framework to explain its existence and efficiency results, and in section Ⅲ, we will use a utility-based probabilistic voting approach in order to build up a specific probabilistic voting model which is applied into the tax policy. In section Ⅳ, we include tax illusion into the probabilistic voting framework to examine the effect of it on the political costs. In section Ⅴ, we will show an empirical example estimating political costs so as to get some implications for tax policy making. In section Ⅵ, we summarize the results we examine.

[1] In our study, the most important aim is to characterize the nature of tax policy choices made by political parties in a probabilistic voting framework. This can be achieved by examining how the political parties or candidates create tax instruments and shape revenue system in order to maximize expected vote as part of its continuous effort to remain in power. Thus, in political equilibrium, tax policy is given and candidates propose this given tax policy. In contrast, political process deals with the process of how tax policy is making. For instance, tax policy making can be affected, in the election, by interest group and lobbying.

Ⅱ. GENERAL PROBABILISTIC VOTING FRAMEWORK

In this section, we explain the existence and efficiency results of probabilistic voting model with candidates' uncertainty.

The major approach incorporating candidate uncertainty into the unidimensional or multidimensional voting model has been to assume probabilistic choices by the voters. That is, each voter is assumed to choose a probability distribution over two candidates' policy alternatives. Thus, the set of possible actions for voters i, A_i, becomes and depends on the probability P^c, for candidate $c=1,2$, instead of policies:

$$A_i=\{(P^1,\ P^2 \mid P^1+P^2=1,\ \text{ for } P^c\in[0,1],\ \text{ for } c=1,2\}$$

where P^1 and P^2 denote probabilities for choosing candidate 1 and 2, respectively.

In a model of candidate uncertainty, the probabilistic choice represents uncertainty of the candidates about what action a given voter will take. Each voter may know exactly how he should vote and why, but the candidates can only estimate voters' behavior, or only know a distribution $F(\theta^c)$ for candidate c's policy θ^c, from which a random voter is chosen.

A major result of probabilistic voting lies in the fact that the *existence* of a candidate equilibrium can be guaranteed by some assumptions. The necessary assumptions generally take the form of *concavity* of certain functions. Let the policy space S be compact. Let each voter i's utility function $U_i(\theta^c)$ be concave in θ^c, policy issues. Let P^1 be a function of $[U_i(\theta^1), U_i(\theta^2)]$ that is 'increasing and concave' in its first argument, $U_i(\theta^1)$, and 'decreasing and convex' in its second argument, $U_i(\theta^2)$. Similarly, let P^2 be decreasing and convex in $U_i(\theta^1)$, and increasing and concave in $U_i(\theta^2)$. Both P^1 and P^2 have ranges contained in the closed unit interval. We will write these probabilities as:

$$P_i^c[U_i(\theta^1), U_i(\theta^2)],\ \text{ for } c=1,2$$

where θ^1 and θ^2 represent the policy issues proposed by the two candidates.

This signify that the functions may differ across voters i. Since P_i^1 and P_i^2 are increasing or decreasing in the specified argument, they behave smoothly as *probability-of-voting functions*:

$$P_i^1[U_i(\theta^1), U_i(\theta^2)], \text{ and } P_i^2[U_i(\theta^1), U_i(\theta^2)]$$

We assume that the candidates know P^1 and P^2, and attempt to maximize expected vote or expected plurality. For instance, the expected vote (EV^1) for candidate 1 is represented as:

$$EV^1(\theta^1, \theta^2) = \sum_{i=1}^{n} P_i^1[U_i(\theta^1), U_i(\theta^2)] \quad (1)$$

Similarly, the expected vote EV^2 for candidate 2 can be defined. Alternatively, the expected pluralities (EP^c) for candidate 1 and 2 are given by:

$$EP^1 = EV^1 - EV^2 \text{ and } EP^2 = -EP^1$$

Now, from the equation (1), assuming the monotonicity and concavity, then P_i^1 is an increasing concave function of a concave function $U_i(\cdot)$ of θ^1, and therefore itself concave in θ^1. Likewise, P_i^1 is convex in θ^2. Similarly, P_i^2 is convex in θ^1 and concave in θ^2. Being a sum of a concave function, EV^1 is concave in θ^1 and convex in θ^2. Likewise, EV^2 is convex in θ^1 and concave in θ^2.

Now, we look at the *existence* results. Hinich(1977) and Ledyard(1984) proved the existence of equilibrium under probabilistic voting. Their model has two features. First is 'functional composition': the probabilities of voting are assumed to be functions of the utility for each platform. Second is concavity and convexity assumption: the probability functions are assumed to be concave or convex in utility, while utility functions themselves are concave in policy. Their main result is to show the existence of equilibrium.

Coughlin and Nitzan(1981) show electoral equilibrium in a welfare maximization. They use the following *Luce's axiom* to show electoral equilibrium in a probabilities of voting with no possibility of abstention:

$$P_i^c(\theta^1, \theta^2) = \frac{U_i(\theta^c)}{U_i(\theta^1) + U_i(\theta^2)}, \quad \text{for } c = 1, 2$$

Notice that $P_i^c(\cdot)$ is concave in $U_i(\theta^c)$ and convex in $U_i(\theta^k)$, $c \neq k$. Then, Coughlin and Nitzan proved the following result concerning the electoral equilibrium theorem in two-candidate competition.

Suppose that for each voter i, there is a lower bound $U_{i\_}$ on utility, and that each voter votes according to the Luce's axiom. Assume that the issue space S is compact and convex, and that candidates maximize the expected plurality. Then, they show that (θ^1, θ^2) is an equilibrium if and only if each θ^c maximizes the objective given as:

$$\sum_{i=1}^{n} \log[U_i(\theta^1, \theta^2) - U_{i\_}]$$

In other words, their result of a two-candidate election is just the Nash bargaining solution of a bargaining game in which a lower bound utility $U_{i\_}$ is the *status quo* utility. Researchers, since Downs(1957), have viewed the *median voter* result as an analogy to the fundamental welfare theorem of economics, but this is the first demonstration that a specific social welfare function is maximized by candidate competition.

Ledyard(1984) also shows electoral equilibrium in a welfare maximization. Assuming that each candidate's objective is to maximize his expected plurality (EP^c), then Ledyard proved a result in the same spirit as that of Coughlin and Nitzan. Suppose that all voters have concave utility functions. Then, (θ^1, θ^2) is an equilibrium for the candidates if and only if each θ^c maximizes $\int_i U_i(\theta^c) \cdot d\mu$, where μ is a probability measure on voters i. That is, the winning policy maximizes social welfare which is the expected sum of all eligible voters' utilities. In particular, Ledyard proved this result by showing that the derivative of EP^1 for candidate 1 with respect to either candidate's policy θ^c, holding the other candidate at θ^k, $c \neq k$, is equal to zero: $\partial EP^1 / \partial \theta^1 = 0$. This is the same as the result when the derivative of the social welfare function is zero: $\partial SW / \partial \theta^1 = 0$. In addition, concavity ensures that second-order conditions for maximization also hold.

Finally, we examine the *efficiency* result. Coughlin(1982) and Palfrey(1984) show the Pareto efficiency result in an electoral equilibrium. They demonstrate that probabilistic voting can lead to *Pareto efficiency*. First, they show the responsiveness. That is, voter i is *responsive* at (θ^1, θ^2) if $U_i(\theta^1) > U_i(\theta'^1)$ implies:

$$P_i^1(\theta^1, \theta^2) \geq P_i^1(\theta'^1, \theta^2)$$
$$\text{and} \quad P_i^2(\theta^1, \theta^2) \leq P_i^2(\theta'^1, \theta^2)$$

and similar conditions hold for θ^2 and θ'^2. A second condition is called 'local responsiveness'. If voter i obeys the first condition with strict inequality for candidate 1 for every θ'^1 in some neighborhood of θ^1, then he is said to be 'locally responsive' for candidate 1 at (θ^1, θ^2). Likewise, a voter may be locally responsive for candidate 2. Then, they proved the following Pareto efficiency result.

Suppose that policy space S is open and convex, that the set of eligible voters is finite, and that their utility functions are quasi-concave. They assume that all voters are 'responsive'. Let θ^2 be fixed. Assume that at least one voter is locally responsive for candidate 1 at (θ^1, θ^2) for all θ^1 within some open set that contains the Pareto set. Then, candidate 1 maximizes his expected plurality against θ^2 only by choosing a position in the 'Pareto set'. This implies that probabilistic voting forces candidate policies *into the Pareto set*. The underlying reason is that the presence of uncertainty causes each strategy *outside* the Pareto set to be dominated by some strategy *within* the Pareto set.

Ⅲ. PROBABILISTIC VOTING MODEL AND TAX POLICY

3.1 Probabilistic Voting Framework

In this section, before applying the probabilistic voting structure into the tax policy, we will introduce a probabilistic voting framework.[2] First, we will call the election concerned 'an election with tax policy'.[3] That is, an election involves the tax policy in our context.

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[2] For this section, we refer to the following literatures : Coughlin (1981,1982), Enelow (1989), Hettich and Winer (1999), Lafay(1993), Winer and Hettich (1998), and Na and Lee (2005).

[3] We will include the tax illusion of voters in the section Ⅳ. In that case, an election will involve the tax policy and voters' misperception on tax policy.

Second, we explain voters' behavior. There are n voters, $i=1,2,\ldots,n$. They are assumed to be 'rational voters': for example, they like benefits from public goods (or like public services) and dislike tax imposition. They all vote sincerely, and thus there is no abstention by voters.[4] Voters have complete information on the candidates and policy issues.[5] Thus, we rule out voter's uncertainty about candidate policy.

Voters care about the 'tax policy platforms' announced by the two candidates.[6] Voters' behavior is well described by a probabilistic voting framework. Each voter may know how he should vote and why, while candidates are *uncertain* about the choices that voters will make on election day. Voters believe that each candidate will carry out the policies that he proposes during the election.

Third, we look at the candidates' behavior. Candidates' expectations about the voters' choice behavior are probabilistic: that is, candidates have uncertainty about voters' choice. Candidates estimate voters' choice and thus there is a probabilistic decision made by candidates. There are two candidates, $c=1,2$, in the election. Both candidates believe that there are n individual voters who will vote in the election and that they will cast all of votes in the election. Each candidate has a common subjective probability. Candidates' uncertainty is classified into the two cases: (i) candidates are uncertain as to whether an individual will vote, but know whom he will vote for if he does vote, and (ii) candidates are also uncertain about whom an individual will vote for when he votes. We will consider only the latter case.

Fourth, we consider the policy spaces S. Policy spaces are compact and convex set. Let $S \subset R^n$ be a compact set of alternatives. Spatial voting models generally interpret the set of alternatives as including *possible platforms of proposed actions and policies*. In addition, some of the dimensions of S identify a candidate's *position* on such issues. This also can expand to include other dimensions of S as identifying *candidate characteristics*, such as age, sex or perceived degree of honesty, intelligence, or experience.

Candidates implement policies if elected : there is policy commitment. Two candidates, 1 and 2, simultaneously announce their policy platforms ahead of the

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[4] However, individual voters may abstain from voting if the proposed policies are too far away from their ideal points.

[5] Later, we will assume that voters have *incomplete* information on the policy issues under the tax illusion.

[6] But, candidates or parties may differ in some other dimension unrelated to this policy : that is, we call this *non-policy issues* such as voters' ideology.

election. We assume either the unidimensional case: tax policy, T^c, for $c=1,2$ or the multidimensional case: tax policy, T^c, and public good, G^c. The party winning the election must implement his promised policy. Here, for analytical convenience, we just suppose that policy space S is unidimensional, $(T^1, T^2) \in S \times S$.

Fifth, we introduce the utility function of voters. We assume that voters vote for the available alternative that yields the highest utility. Voters' choice about candidates is based on the indirect utility. Voters evaluate policy proposals according to preferences or indirect utility levels, $U_i(T^c)$, where T^c represents tax policy. Voters' utility depends on the policy issues proposed by the candidates. Utility function[7] forms the *utility difference*, $U_i(T^1) - U_i(T^2)$. We assume that utility function is continuous and concavity : that is, $U_i(T^c)$ is continuous and concave in T^c:

$$U_i(T^c), \quad \frac{\partial U_i}{\partial T^c} < 0, \quad \frac{\partial^2 U_i}{\partial T^c \cdot \partial T^c} < 0, \quad c=1,2$$

Sixth, we turn to specify the probability voting function. For each voter $i \in n$ and candidates $c \in [1,2]$, there is a function P_i^c which is represented as:

$$P_i^c : (T^1, T^2) \in S \times S \rightarrow [0,1]$$

This assigns, to each tax policy $(T^1, T^2) \in S \times S$, a *probability* for the event 'a voter randomly drawn from the individuals i will vote for candidate c if candidate 1 proposes T^1 and candidate 2 proposes T^2'. These probabilities can be objective probabilities or they can be subjective probabilities that are believed by both of the candidates. Thus, probabilistic voting function for single dimension policy is specified as:

$$P_i^c(T^1, T^2) = P_i^c[U_i(T^1), U_i(T^2)], \quad c=1,2$$

where $P_i^c(\cdot)$ is a smooth and continuous function. For instance, $P_i^1(\cdot)$ for candidate 1 is increasing in the first argument, $U_i(T^1)$ and decreasing in the

[7] Alternatively, the utility function can take the form of the *utility ratio*, $U_i(T^1)/U_i(T^2)$.

second, $U_i(T^2)$. This smoothness implies that a small unilateral deviation by one party does not lead to jumps in its expected vote and thus gives rise to well-defined equilibrium. We will assume that these probabilities can take the form of the '*utility difference*':

$$P_i^c(T^1, T^2) = P_i^c[U_i(T^1) - U_i(T^2)]$$

Seventh, we see the connection between policy and probability, and expected vote. For a candidate to be able to decide which policy will be the best one to achieve his goal of maximizing his expected vote, it will be necessary for him to have a clear idea of the *connection* between the policy proposals of the two candidates and the probability of getting any given individual's vote. This connection will have the following property: for any given pair of policy platforms, $(T^1, T^2) \in S \times S$, the two candidates have a common subjective probability $P_i^1(T^1, T^2)$ for the event 'voter i will vote for candidate 1 if candidate 1 proposes T^1 and candidate 2 proposes T^2'. Similarly, both candidates have a common subjective probability $P_i^2(T^1, T^2)$ for the event 'voter i will vote for candidate 2 if candidate 1 chooses T^1 and candidate 2 chooses T^2'. Thus, we assume the full participation of voters as:

$$P_i^1(T^1, T^2) + P_i^2(T^1, T^2) = 1$$

In sum, we summarize the probabilistic voting mechanism that we explained so far. First, candidates or parties are uncertain about how voters will cast their vote in the next election: probabilistic voting from voters to candidates. Second, candidates or parties view all voters (not median voters) as potential supporters. Third, each voter has a different probability of voting for the party. Fourth, candidates or parties structure their platforms or policies so as to maximize the expected vote or expected plurality, and keep adjusting policies continually toward this objective. Fifth, voters evaluate different policies according to the utility that they will receive from the platforms, and cast their vote accordingly. Finally, resulting voters' utility determines voting probabilities for the candidate.

Eighth, we consider the candidate's objective function. Each candidate wants to maximize his 'expected vote or political support' (EV^c).[8] We assume thus that candidates want to maximize the expected vote. Among available models, the 'expected vote maximization' appears most relevant to deal with tax structure in a democratic setting since it satisfies the desirable characteristics of both accommodating *multidimensional choices* and having a *well-defined and stable equilibrium*. This model differs from other approaches by treating voting choices as probabilistic and by assuming that candidates maximizes expected votes, while being uncertain of 'how voters will respond to their platforms'.

Normalizing that the total expected vote from all of voters is 1, the expected vote (EV^c) for a given candidate c can be written as:

$$EV^c(T^1, T^2) = \sum_{i=1}^{n} P_i^c(T^1, T^2), \text{ for } c=1,2$$

where $EV^c: S \times S \rightarrow R$ will be called the '*expected vote function*' for candidate c. For instance, candidate 1 sets T^1 to maximize his expected vote which is given as:

$$\begin{aligned} EV^1(T^1, T^2) &= \sum_{i=1}^{n} P_i^1(T^1, T^2) \\ &= \sum_{i=1}^{n} P_i^1[U_i(T^1) - U_i(T^2)] \end{aligned}$$

Finally, we turn to examine the political optimal tax structure in a probabilistic voting framework. The candidate 1 or governing party aims to maximize the political support, or expected vote, subject to budget constraint and general equilibrium structure:

$$Max\ EV^1 = \sum_{i=1}^{n} P_i^1[U_i(T^1) - U_i(T^2)]$$

$$s.t.\quad TR^1 = \sum_{i=1}^{n} T_i^1 \cdot B_i^1 \text{ and } B_i^1 = B_i^1(T_i^1),\ \frac{\partial B_i^1}{\partial T^1} < 0$$

where $P_i^1(\cdot)$ represents the probability perceived by the candidates that voters vote for candidate 1, TR^1 is the total tax revenues of candidate 1, and B_i^1 denotes tax base that candidate 1 obtains from voters i. Tax base is a function of tax policy, or tax rates. We suppose that these probabilities are independent

[8] Alternatively, each candidate can maximize his expected plurality (EP).

events for different voters. Similarly, candidate 2 faces a symmetric problem in maximizing his expected vote.

3.2 Utility-based Probabilistic Voting Approach

Hettich and Winer(1988, 1997) model is based on the net benefit : thus, this is known as a net benefit probabilistic voting approach. The net benefit in their model is defined as the benefit from public services minus the full income loss from taxation. They assume that (i) the probability of voting or supporting for the candidates or government is influenced positively by the benefits from a pure public good, (ii) the probability of voting or supporting for the government is affected negatively by the loss in full income from taxation,[9] (iii) voters see no connection between public services and tax burden: that is, there is a separation of taxes and public expenditure, and (iv) in probability voting model, the structure of 'private economy' enters through tax bases.

However, we employ a probability voting approach based on voters' utility, rather than the net benefit : thus, this is referred to as a *utility-based probability voting approach.* This method has an advantage of expressing political costs *directly* compared to the net benefit method. That is, tax imposition affects voters' utility which influences, in turn, the winning probability of candidates. First, we assume that two candidates or parties, 1 and 2, compete with single policy issue (i.e., tax policy):[10] (T^1, T^2). Note that we ruled out the case of multiple policy spaces, tax and public service. We defined voters' utility function in the previous section as: $[U_i(T^1), U_i(T^2)]$. The utility function is decreasing and concave:

$$[U_i(T^1), U_i(T^2)], \quad \frac{\partial U_i}{\partial T^1} < 0, \quad \frac{\partial^2 U_i}{\partial T^1 \cdot \partial T^1} < 0$$

[9] We can assume *either* that the probability of voter i's supporting or voting for the government is influenced positively by the benefits received from a public good, *or* negatively by his loss in full income from taxation. But, Hettich and Winer model considers both policies in a single equation.

[10] Alternatively, we can assume that two parties or candidates compete with single public good: (G^1, G^2). Then, the first-order condition for candidate 1 to maximize the expected vote will be given as: $(\partial P_i^1/\partial U_i)(\partial U_i/\partial G^1) = \lambda$. That is, the marginal political benefit (*MPB*) from the public good would be equalized between voters.

Then, the probability for voting for candidate 1, P_i^1, depends on the utility difference derived from the tax policy proposed by each candidate: $P_i^1 = P_i^1[U_i(T^1) - U_i(T^2)]$. We suppose that candidates maximize the expected vote. Then, the candidate 1, for instance, has the following objective to maximize the expected vote:

$$Max\ EV^1 = \sum_{i=1}^{n} P_i^1[U_i(T^1) - U_i(T^2)]$$

$$s.t.\quad TR^1 = \sum_{i=1}^{n} T_i^1 \cdot B_i^1 \text{ and } B_i^1 = B_i^1(T_i^1)$$

$$\frac{\partial P_i^1}{\partial U_i} > 0,\quad \frac{\partial U_i}{\partial T^1} < 0,\quad \frac{\partial P_i^1}{\partial U_i} \cdot \frac{\partial U_i}{\partial T^1} < 0$$

where the first constraint denotes the 'balanced budget constraint' and the second constraint represents the 'private economy' which reflects the voter's utility-maximizing response to taxation. In addition, TR^1 or $\sum_i T_i^1 \cdot B_i^1$ is the total tax revenue for candidate 1, and $B_i^1 = B_i^1(T_i^1)$ represents the tax base of candidate 1 which is a function of tax policy, or tax rates.

Each candidate attempts to maximize his expected vote. For instance, the candidate 1 maximizes the expected vote to derive the first-order conditions. Then, the first-order conditions for candidate 1 are obtained by differentiating the expected vote with respect to tax rate T^1 as follows:

$$\frac{\dfrac{\partial P_i^1}{\partial U_i} \cdot \dfrac{\partial U_i}{\partial T^1}}{\left[B^1 + T^1 \cdot \dfrac{\partial B^1}{\partial T^1}\right]} = -\lambda \tag{2}$$

Now, looking from the equation (2), the numerator is negative since $(\partial P_i^1/\partial U_i) \cdot (\partial U_i/\partial T^1) < 0$. The denominator in the equation represents the rate-revenue relation, or 'Laffer curve', and is assumed to be positive.[11] This implies the revenue gain to the candidate from an increase in taxation: $\partial TR^1/\partial T^1 > 0$. In addition, the Lagrange multiplier λ is associated with the budget constraint. Specifically, the numerator in the equation (2) indicates the marginal political costs (*MPC*) and the denominator denotes additional revenue

[11] In other words, the denominator represents the so-called *Laffer curve* effect.

from taxation. In fact, this is negative, implying the 'marginal vote loss' per dollar of revenue gain from taxation. The numerator in the equation (2) represents the 'economic and political' effect of taxation on the probability which is negative, implying the 'vote loss' from an increase in taxation. In essence, the condition (2) indicates that the evolution of tax structure is closely related to economic change (i.e., tax burden) and political change (i.e., political losses from taxation, or *marginal political costs*, $\partial P^1/\partial U_i < 0$).

It is worth to note that the equation (2) integrates both economic and political factors. Tax structure in the equation (2) consists of n tax rates on one activity, with each voters being taxed at a different rate. This equation implies that each candidate adjusts tax rates among voters until the reduction in expected votes, or the marginal political costs, from raising an additional tax revenue is equalized across voters i. Thus, the political optimal tax structure is required to minimize total political costs for an additional tax revenue.

Thus, this equation implies that the politically optimal tax structure requires marginal political costs per dollar of additional tax revenue to be equalized across voters i for a given activity. From this, we summarize the following result.

Proposition 1: the politically optimal tax structure requires a choice of tax policy that equalizes marginal political costs per dollar of additional revenue across all voters i for a given activity.

The resulting tax structure is *complex*, with economic and political factors considered. Thus, minimizing opposition to taxation, or maximizing political support, requires the *adjustment of tax structure* both when the nature of *economic* activities conducted by voters changes and when the nature of *political* behavior is altered. The government *adjusts* tax rates among voters until the reduction in expected votes, or marginal political costs, of raising an additional dollar is *equalized* between all voters. In other words, the politically optimal tax structure minimizes political costs for any given level of revenues collected.

In our basic model, we examined only the case with single policy. But, we might consider, as *multiple* policy spaces, tax and public service simultaneously, but we assume there is a separation between them. We assume that two parties compete with two policy issues, tax and public service, but there is no link between them. Then, candidates attempt to maximize the expected vote. Now, the first-order conditions for candidate 1 can be obtained by differentiating the expected vote with respect to tax and public service. From the first order conditions, we can describe the characteristics of the political optimal tax structure in the case of multiple policies as:

(i) the politically optimal tax structure requires a choice of tax rates that equalize marginal political costs (*MPC*) per dollar of additional revenue across all voters for a given activity.

(ii) the politically optimal tax structure requires public services that equalize marginal political benefits (*MPB*) across voters.

(iii) The marginal political costs (*MPC*) should be equal to the marginal political benefits (*MPB*): this is known as 'balancing act'. That is, tax policy must be adjusted until the marginal loss of expected votes from additional tax revenue is equal to the gain in votes from using the additional revenue to supply more public services.

Furthermore, in Hettich and Winer models, the tax and expenditure sides are linked only through the budget constraint and the endogenous determination of budget size. However, Kiesling (1990) assumed that tax base activity, B_i, depends also upon the perceived benefits from *multiple* public goods or public expenditure, G_k, and then examined the interactions between tax base and multiple public services:

$$B_i = B_i(T_i^c, G_k), \quad i = 1, 2, \ldots, n \text{ and } k > 1$$

This implies that voters adjust their tax bases because of both the tax rates T_i^c, and the amount and kind of public goods they perceive from their taxes, G_k.

Then, the first-order condition with respect to tax policy in order to maximize political support gives the following result:

$$\frac{\dfrac{\partial P_i^1}{\partial U_i} \cdot \dfrac{\partial U_i}{\partial T^1}}{\left[B_i^1 + T_i^1 \cdot \dfrac{\partial B_i^1}{\partial T_i^1}\right] + T_i^1 \cdot \Sigma_k \dfrac{\partial B_i^1}{\partial G_k}} = -\lambda \tag{3}$$

where $\Sigma_k \partial B_i^1 / \partial G_k$ in the denominator represents effects of the public goods being provided on the tax bases. For example, if $\partial B_i / \partial G_k > 0$, then the provisions of public goods become popular among voters: *popularity effect.* This implies that the politically optimal tax structure has tax policy that equalizes marginal political costs per dollar of additional revenue across voters *including* the effects of the public goods provided on tax bases. In particular, the denominator includes a new term which describes the effects of public goods provision on the tax bases. Furthermore, Kiesling suggests that there are relations of 'complementarity' and 'substitutability' between public goods and different tax bases. There is a complementarity relation if $\partial B_i/\partial G_k > 0$. On the contrary, there will be a substitutability relation if $\partial B_i/\partial G_k < 0$.

3.3 Voting Equilibrium Interpretations

3.3.1 Economic and Political Weights in Voting Equilibrium

The approaches to probabilistic voting adopted in our model and Hettich and Winer model focus on the modeling of 'political equilibrium' instead of the political process. That is, we attempt to characterize the political equilibrium of the tax policy, and interpret the political equilibrium. The first order conditions tend to indicate that tax structure is related to economic change and to changes in political margins. This implies that economic and political factors across voters affect opposition to taxation and thus, the possibility of electoral defeat.

Next, we will examine economic and political weights in voting equilibrium. First, we assume that all political margins across voters are the same as follows:

$$\frac{\partial P_i^1}{\partial U_i} = \frac{\partial P_k^1}{\partial U_k} \equiv \frac{\partial P^1}{\partial U} \quad \text{for} \quad i \neq k$$

Dividing both sides by $\partial P^1/\partial U$, then the equation (2) becomes as :

$$\frac{\dfrac{\partial U_i}{\partial T^1}}{\left[B^1 + T^1 \cdot \dfrac{\partial B^1}{\partial T^1}\right]} = \frac{-\lambda}{\left(\dfrac{\partial P^1}{\partial U}\right)}$$

This equation shows that when only economic responses to taxation *differ* between voters, then the political optimal tax system equalizes the loss in full income from taxation, $\partial U_i/T^1$, per dollar of additional revenue across voters:

$$\frac{\partial U_1}{\partial T^1} = \frac{\partial U_2}{\partial T^1} = \cdots = \frac{\partial U_n}{\partial T^1}$$

As a consequence, the political optimal tax system minimizes the total economic burden of taxation for a given revenue.

Second, we suppose that all economic responses to taxation from voters are the same as:

$$\frac{\partial U_i}{\partial T^1} = \frac{\partial U_k}{\partial T^1} \equiv \frac{\partial U}{\partial T^1} \text{ for } i \neq k$$

Then, we focus on the difference in political margins across voters. In this case, the equation (2) becomes now as:

$$\frac{\dfrac{\partial P_i^1}{\partial U_i}}{\left[B^1 + T^1 \cdot \dfrac{\partial B^1}{\partial T^1}\right]} = \frac{-\lambda}{\left(\dfrac{\partial U}{\partial T^1}\right)}$$

Thus, the political optimal tax system equalizes the political opposition, $\partial P_i^1/\partial U_i$, across voters:

$$\frac{\partial P_1^1}{\partial U_1} = \frac{\partial P_2^1}{\partial U_2} = \cdots = \frac{\partial P_n^1}{\partial U_n}$$

In particular, Hettich and Winer (1998) defined $\partial P_i^1/\partial U_i$ as 'political weights'. Similarly, we define $\partial U_i/\partial T^1$ as 'economic weights'. But, the problem of the choice of *political weights* is a difficult task. There may be no a suitable set of political weights. In a perfectly competitive political system, all the $\partial P_i^1/\partial U_i$ must be equal. For instance, in the case of cost-benefit analysis, this weight can infer a set of 'distributional weights' from choices across different projects. Alternatively, it may be reasonable to assume that the Hicks-Kaldor criterion based on *equal weighting* is appropriate.

Finally, we will show the 'Pareto efficiency' result and prove the 'representation' theorem:[12] (i) in probability voting model, the electoral

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[12] In other words, the representation theorem means that there is an *equivalence* between the expected vote maximization and the social welfare maximization.

equilibrium is Pareto efficiency, and (ii) $\partial P_i^1/\partial U_i$ (maximization of expected votes) can be *represented* by θ_i (maximization of weighted social welfare function). First, policy choices characterized by the equation (2) are consistent with Pareto efficiency. Second, the equation (2) also represents a solution to the problem of choosing a fiscal system to maximize a political support (PS) function (or equivalent to social welfare function), $PS=\sum_{i=1}^{n}\theta_i\cdot U_i(T^1)$ subject to the government budget constraint, where θ_i is political weights to the social welfare.[13] If we maximize the political support (*PS*) with respect to T^1, then we can get the following first-order condition:

$$\sum_{i=1}^{n}\theta_i\cdot\frac{\partial U_i}{\partial T^1}$$

Now, if we assume that $\theta_i=\partial P_i^1/\partial U_i$, then this represents the perceived responsiveness of expected voting to a change in individual utility at a Nash equilibrium. Alternatively, θ_i measures the effective political influence exerted by different voters on policy outcomes. Thus, the electoral equilibrium outcome is a *representation* of the weighted social welfare maximization.

3.3.2 Distributional Characteristic and Voting Characteristic

Now, we compare voting characteristic with distributional characteristic. Just as the social welfare function affects the 'distributional characteristic', so the vote maximization affects the 'voting characteristic'. The standard analyses of marginal efficiency cost fund and marginal efficiency benefit may be useful for a government with an objective other than maximizing social welfare. For example, if the government is a maximizer of votes as in the Hettich and Winer(1997, 1999), then the objective function is represented by the probability function we examined so far:

$$P[U_1(y_1),\dots,U_n(y_n)],\quad i=1,2,\dots,n\ \text{(voters)}$$

where y_i is voter i's income level and is assumed to be a function of tax

[13] Here, the summation of individual utilities, $\sum_{i=1}^{n}U_i(T^1)$, means social welfare.

rate t_i, and $P[\cdot]$ represents the probability of voting for the government as a function of the utility level of the individual voters.

First, using this probability function, and by differentiating the probability function with respect to income, then we define β_i^{vc} as:

$$\beta_i^{vc} \equiv \frac{\partial P}{\partial U_i} \cdot \frac{\partial U_i}{\partial y_i}, \text{ with } \frac{\partial P}{\partial U_i} > 0, \ \frac{\partial U_i}{\partial y_i} > 0$$

Then, we use this definition to derive voting characteristic which relates the probability function and tax policy. Voting characteristic for commodity j, VC_j, is defined by differentiating the probability function with respect to tax rate:

$$\begin{aligned} VC_j \equiv \frac{\partial P}{\partial t_i} &\equiv \sum_{i=1}^{n}\left[\frac{\partial P}{\partial U_i} \cdot \frac{\partial U_i}{\partial y_i}\right] \cdot \frac{\partial y_i}{\partial t_i} \\ &= \sum_{i=1}^{n} \beta_i^{vc} \cdot \frac{\partial y_i}{\partial t_i}, \text{ with } \beta_i^{vc} > 0, \ \frac{\partial y_i}{\partial t_i} < 0 \end{aligned}$$

where β_i^{vc} represents the government evaluation of the change in probability to vote for the government of the ith voter.

Thus, voting characteristic VC_j will be a weighted average of β_i^{vc} weighted by the burden imposed on voter i in raising the tax revenue.

Second, we specify the distributional characteristic DC_j for commodity j as:

$$\begin{aligned} DC_j &\equiv \sum_{i=1}^{n}\left[\frac{\partial W}{\partial V_i} \cdot \frac{\partial V_i}{\partial y_i}\right] \cdot s_i^j \\ &= \sum_{i=1}^{n} \beta_i^{dc} \cdot s_i^j, \text{ for } i = voters \text{ and } j = commod\,ities \end{aligned}$$

where $(\partial W/\partial V_i) \cdot (\partial V_i/\partial y_i) \equiv \beta_i^{dc}$ represents the social evaluation of the marginal utility of income, and s_i^j means the share of each individual i in the burden of raising the tax revenue for commodity j.

This is the *distributional characteristic* of a commodity j which was defined by Feldstein(1992). This implies a weighted average of the social evaluation of the marginal utility of income, β_i^{dc}, weighted by the share of each individual in the burden of raising the tax revenue, s_i^j. In other words, s_i^j describes the incidence of a dollar burden of taxes, raised through the change in commodity tax.

From these definitions, we infer a similarity between voting characteristic and distributional characteristic. Voting characteristic in voting equilibrium is similar to distributional characteristic in welfare economics in that the former represents the effect of a change in income on the probability to vote for a candidate, while the latter indicates the effect of a change in income on the social welfare.

Ⅳ. PROBABILISTIC VOTING FRAMEWORK UNDER TAX ILLUSION

In this section, we attempt to extend our basic model in which we assumed tax policy is perceived accurately by voters. But, tax policy is often perceived *imperfectly* by voters. We will incorporate tax illusion into the probabilistic voting framework and examine the effect of tax illusion on the political costs.[14]

First, we explain fiscal illusion briefly. In general, 'fiscal illusion' refers to a systematic misperception of fiscal parameters, such as tax and expenditures. The phenomenon of fiscal illusion has the notion that the systematic misperception of key fiscal parameters may significantly distort fiscal choices by the electorate or taxpayers. For example, various elements of the tax structure may be largely hidden so that voters do not perceive the entire costs of providing certain public services: thus, there exists tax illusion.

Various studies of revenue structure and tax consciousness suggest that significant elements of the tax system are largely hidden and underperceived by taxpayers. From this perspective, it is the costs or taxes of public services that are subject to significant underestimation. This may stem, in part, from deliberate efforts by the government to disguise the full costs of their programs and to exaggerate the associated benefits. For example, the tax system includes important elements, like tax withholding, and forms of taxation with obscure patterns of incidence that conceal the real cost of public programs. Thus, tax illusion results in a public sector of excessive size.

In particular, one source of fiscal illusion has received large attention in the literature: complexity of the tax structure.[15] We examine the complexity of the

[14] We will rule out the case of 'benefit illusion'.

[15] In addition, main sources of fiscal illusion come from the renter illusion with respect to property taxation, the income elasticity of the tax structure, the debt illusion, and the flypaper effect.

tax structure and its relationship with Herfindahl index. Thus, we suppose here that tax illusion stems from the complexity of the revenue or tax structure. According to this hypothesis, the more complicated the tax revenue system, the more difficult it is for the taxpayers to determine the tax-price of public outputs, and thus the more likely it is that they will underestimate the tax burden associated with public programs. This hypothesis implies that the more complex the tax revenue system, the larger will be the public budget.

In particular, Wagner (1976) undertook the first test of the tax revenue complexity hypothesis. Wagner regressed total expenditure on a set of socio-economic variables and a measure of the complexity of the revenue system. Moreover, Wagner uses Herfindahl index as a measure of revenue complexity. He assumed that there are four revenue sources: for instance, property taxes, general sales taxes, selective excise taxes, and charges and fees. Then, the Herfindahl index (*HI*) is defined as:

$$HI = \sum_{s=1}^{4} \frac{TR_s}{TTR}, \text{ with } 0 < HI \leq 1, \text{ for } s = 1, 2, 3, 4$$

where *TTR* represents total tax revenues, TR_s denotes tax revenue from tax sources s, $s = 1, 2, 3, 4$.

The Herfindahl index will achieve its maximum value of unity if the government concerned generates all of its own revenues from a single source, and the minimum possible value would be one-fourth (or 0.25) if revenues were divided equally among the four categories. A higher value (or ≈ 1) of the index is associated with a less complex (or more simple) revenue system so that the 'revenue complexity hypothesis' posits a negative coefficient in his estimation model. Furthermore, a higher value of the index is associated with smaller levels of public expenditure. In other words, a lower values (or ≈ 0 or more complex) of the index is associated with larger levels of public expenditure.

In addition, the *visibility* of the various classes of revenue is likely to vary greatly across voters. For example, a heavier reliance on 'charges and fees' (highly visible) will provide a more direct sense of the cost of public outputs than a similar reliance on 'selective excise taxation' (less visible). We might expect the extensive use of selective excise taxation to generate a higher level of spending than one which uses charges and fees. Alternatively, we can employ 'tax invisibility index' to measure tax illusion.

Furthermore, Downs(1960) argued that the benefits of most government programs tend to be remote and largely unrecognized by the electorate, while the taxes to provide these programs are more directly recognized and perceived. The more pronounced tendency towards a systematic underestimation of public benefits than costs would lead the electorate to support a small allocation of resources to the government sector.[16]

In turn, we will examine tax illusion instead of fiscal illusion. Voters base their demand for public programs on expected costs and benefits. An important issue in public finance concerns the ability of voters to understand the true nature of costs and benefits of public programs. Without perfect information, voters' demands for public programs must be based on *perceived* costs and benefits, rather than actual ones. Thus, the tax illusion hypothesis proposes that voters base their demands on an illusion that the perceived costs (i.e., taxes or tax burdens) of public programs are lower than true costs. An important implication of the tax illusion hypothesis is that, because the net benefit for any public program is measured as the difference between benefits and costs (i.e., net benefit), net benefits are overestimated whenever costs are underestimated. Therefore, this hypothesis predicts that the public sector overexpands whenever net benefits are overestimated by misinformed voters. One possible reason why voters may underestimate costs of public programs is complexity of the tax system. Thus, a possible remedy for removing tax illusion is simplification of tax policies. There is mixed empirical support for the hypothesis that voters underestimate the tax bills of public programs. For instance, Wagner supports this hypothesis, but others rejected it. However, a survey of the empirical evidence finds overall support for the hypothesis.[17] In addition, empirical works on tax illusion suggest that they may provide for varying magnitudes of illusion over different values of the tax parameters.

Third, while voter's tax illusion exists, fiscal illusion also arises over the benefits of public programs.[18] Then, the *benefit illusion* hypothesis proposes that because voters underestimate the benefits of public programs, the underexpansion of public programs occurs from the resulting underestimation of net benefits. A

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[16] However, in the more recent public choice literature, the attention to special interest groups and associated lobbying efforts has called into question the presumed lack of support for public spending.

[17] See Oates(1988) for an empirical survey.

[18] Downs(1960) contends that only relative unawareness of certain government benefits in relation to their cost is necessary to cause a smaller budget.

possible remedy for removing benefit illusion is to develop policies that attempt to inform voters about the true nature of benefits, such as 'fiscal connecting policy'.[19]

Finally, we examine tax illusion in a probabilistic voting framework. Probabilistic voting models have incorporated the uncertainty about how voters respond to platforms into expected vote maximization in a two-party system. Now, we combine explicitly the tax illusion related to the complexity of the tax system into the probabilistic voting model. From this consideration, we expect that tax illusion increases the complexity of the tax system and decreases the political costs and thus provides an incentive for the candidates to increase the complexity.

Hettich and Winer(1988) model examined the case with no tax illusion. That is, they assume that voters know the tax policies proposed by two parties. In other words, voters accurately assess their perceived tax policy, such as tax rates or tax payments. But, we will extend our model to incorporate 'tax illusion' in the utility-based probability approach.

First, we assume that voters have *inaccurate* perceptions of tax policy proposed by candidates.[20] To allow for tax policy misperceptions, we define the *perceived* tax policy, T_i^{per}, by voters i for each party c as:

$$T_i^{per} = \Phi_i \cdot t^c, \quad c = 1, 2$$

where t^c is the *actual* tax policy proposed by candidates c, and Φ_i is tax misperception or tax illusion parameter perceived by voters i: tax perception can be overestimated ($\Phi_i > 1$) or underestimated ($\Phi_i < 1$).[21]

With this specification of tax illusion, we examine the effect of *underestimated tax illusion* on voting equilibrium and political costs. The following result shows the effect of tax illusion on the political costs.

Proposition 2: Assuming that there is underestimated tax illusion ($\Phi_i < 1$), then the marginal political costs (MPC^{TI}) under tax illusion now depend on the

[19] This implies that tax levy is related directly to benefits, such as earmarked tax.

[20] The 'tax misperception' can be classified into three classes : tax payment misperception, tax base misperception and tax rate misperception. But, we consider only *tax policy misperception.*

[21] Voters perceive tax policy accurately in the case of $\Phi_i = 1$.

voter i's tax illusion parameter, Φ_i:

$$MPC^{TI} = -\Phi_i \cdot \frac{\partial P_i^1}{\partial U_i} \cdot \frac{\partial U_i}{\partial t^1}, \quad 0 < \Phi_i < 1 \tag{3}$$

Thus, the extent of political costs depends on the voter i's tax illusion parameter, Φ_i. If $\Phi_i < 1$, then voters underestimate tax policy such as the case of indirect tax. In contrast, if $\Phi_i > 1$, there are overestimations by voters. Note that $\Phi_i = 1$ means an accurate or exact estimation of tax policy, like income tax.

Now, we turn to compare the political costs between 'no tax illusion' and 'tax illusion' cases. The following result shows the political costs between both cases.

Corollary 1: Assuming that $\Phi_i < 1$, then the *underestimated* tax illusion leads to political costs which are *lower* than that of no tax illusion:

$$\left[\frac{-\frac{\partial P_i^1}{\partial U_i} \cdot \frac{\partial U_i}{\partial T^1}}{\left[B^1 + T^1 \cdot \left(\frac{\partial B^1}{\partial T^1}\right)\right]}\right]^{noTI} > \left[\frac{-\Phi_i \cdot \frac{\partial P_i^1}{\partial U_i} \cdot \frac{\partial U_i}{\partial t^1}}{\left[B^1 + T^1 \cdot \left(\frac{\partial B^1}{\partial T^1}\right)\right]}\right]^{TI} \tag{4}$$

The left-hand side represents the case of 'no tax illusion' and the right-hand side the case of 'tax illusion'.[22] Thus, the tax illusion underestimated tends to make political costs *lower*.

This equation has two important implications. First, candidates or political parties have an incentive to make tax system less visible. In other words, underestimated tax illusion tends to increase the complexity of the tax system. Second, political parties are likely to rely on '*less visible revenue sources*' to raise revenues since the political costs are decreased under the case of underestimated tax illusion. This corresponds to the rational ignorance that voters face because of gathering information concerning tax policy or burden. Thus,

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[22] Note that ∂T^1 indicates the case of no tax illusion, and $\Phi_i \cdot \frac{1}{\partial t^1}$ represents the case of tax illusion in the equation (4).

candidates attempt to make most of this ignorance in the election. Therefore, each candidate has an incentive to manipulate tax illusion underestimated by voters in order to keep marginal political costs as small as possible. In addition, this corollary provides a chance to test this empirically. We thus use an existing empirical example so as to examine this implication in the next section.

V. POLITICAL COSTS OF TAXES: AN EMPIRICAL EXAMPLE

In this section, we will first show an existing empirical result of the political costs. In particular, Landon and Ryan(1997) examined the voters' behavior, in order to examine political costs of fiscal policies, such as tax and expenditure policies.

Landon and Ryan examined the impact of disaggregated taxes and government expenditures on voters' voting behavior and on the political success of the incumbent political party. The utility of each voter depends on disaggregated government taxes and expenditures. Voters will allocate their votes to the party that is expected to increase their utility by the greatest amount. They assumed that the objective functions for the incumbent party is to maximize the percentage of the vote. They assumed a voting model as the percentage of the vote won by the incumbent: that is, the dependent variable is the incumbent's percentage of the vote from voters. They provided important empirical evidences on voter preferences over taxes and expenditures as well as on the relative marginal political costs of different fiscal policies. They defined the marginal political costs (*MPC*) of particular fiscal (taxes and expenditures) policies as the effect of changes in various taxes and expenditures on the vote percentage.

Here, we focus on a few important implications from their estimation results on the tax variables. They focused on the case that dependent variable is the percentage of vote obtained by the incumbent: that is, the incumbent's vote percentage is the dependent variable in their estimation model. They assumed that tax variables include direct taxes on persons, corporate taxes, gasoline tax, natural resource taxes, sales taxes, miscellaneous indirect taxes, license and other fees, and provincial property tax. Then, Landon and Ryan calculated the political cost of a dollar increase in each per capita tax variables. For the case of the percentage of vote for incumbent party, their results indicate that increases in license and other fees tend to have a large 'positive' impact on the incumbent's vote percentage. However, an increase in sales tax leads to vote loss for the incumbent party. Only those coefficients associated with the sales tax and license fees are significant, resulting in an increase in sales tax reducing the percentage of the incumbent's vote and an increase in license and other fees increasing this percentage (See Table 1). Though insignificant, all the other tax variables, except sales taxes and license fees, have 'negative' coefficients, implying that tax increases may have a negative impact on the tendency of voters to vote for the incumbent party.

It is worthy of noting that considerable variation is found in the 'marginal political cost estimates' of the different types of taxes. In general, the most *visible taxes* (sales taxes, gasoline taxes and direct taxes on persons) have the largest systematic *political costs*. The significantly positive impact of 'license and other fees' on the incumbent's *political success* would suggest a distinct voter preference for 'user pay method' of financing publicly provided goods.

Then, we compare two different empirical results in order to have some implications for tax policy. As we examined, Landon and Ryan estimated the political cost of different taxes. In contrast, Jorgenson and Yun(1991) estimated the 'marginal efficiency costs' of several different taxes for the United States. Now, by comparing both empirical results, we can, in turn, infer some insightful implications as follows. The differences in the marginal political costs of the various types of taxes can influence the tax policies of governments. If the relative *political* costs of different taxes are *positively* correlated with their relative *economic* efficiency costs, governments may choose the *most efficient taxes* while attempting to minimize the political costs of taxation. On the other hand, if the political and efficiency costs are *negatively* correlated, governments may be more likely to choose tax instruments that are *less efficient*, but *politically less costly*. For example, sales taxes have a larger marginal political cost than direct taxes from the result of Landon and Ryan, but a lower marginal efficiency cost than direct taxes from Jorgenson and Yun (See Table 1). This comparison suggests that governments attempting to reduce the political costs of revenue generation may *not* choose taxes with the lowest marginal efficiency costs.

In addition, a couple of implications can be drawn from the results of Landon and Ryan's estimation. First, governments that want to raise their percentage of the vote are likely to reduce their reliance on *broad-based visible* taxes (such as sales taxes, gasoline taxes and income taxes) and concentrate on raising revenue from *less visible* revenue sources (such as natural resource royalties, corporate taxes and user fees). Second, because of the 'differences' between the relative marginal economic and relative marginal political costs of particular taxes, governments are *unlikely* to choose the 'tax mix' that minimizes the economic costs of taxation. Finally, tax policy tends to have a potentially large impact on voters' behavior in the election.

[Table 1] Marginal Political and Efficiency Costs of Taxes

Tax type	Marginal Political Costs[1)]	Marginal Efficiency Costs[2)]
Direct taxes on persons	-0.00077	0.508
Corporate taxes	-0.00018	0.838
Gasoline tax	-0.00086	
Natural resources taxes	-0.00049	
Sales tax	**-0.00171****	**0.256**
Miscellaneous indirect taxes	-0.00066	
License and other fees	+0.00307***	
Provincial property tax	-0.00072	0.174

Note: 1. Landon and Ryan assumed that the dependent variable is the percentage of vote for the incumbent party.
2. 1) Marginal Political Costs are defined as the average change in the percentage of the vote going to the incumbent party in response to a dollar change in each tax, and 2) Marginal Efficiency Costs are defined as the efficiency costs (or welfare burden) of raising an additional dollar of revenue.
3. ** denotes the significance at the 5 percent level and *** denotes the significance at the 1 percent level.

Sources: 1) Landon and Ryan(1998) for marginal political costs.
2) Jorgenson and Yun(1991) for marginal efficiency costs.

Ⅵ. CONCLUDING REMARKS

The essential stylized facts of observed tax systems can be seen as the outcome of optimizing economic and political behaviors. Despite the fact that the tax structure is a product of the political process, rarely does an economic analysis of tax policy take account of the political environment within which the tax structure is designed. The political environment is important, because the tax structure is a product of politics, and thus one must understand the political process to understand the tax system. In a world where vote-maximizing political parties compete for office, tax structure will be complex, consisting of a system of interdependent elements including multiple bases and rates, and special provisions, with the structure and level of taxation being determined endogenously. Thus, any analysis of tax policy that does not consider the political environment must be viewed as incomplete.

Among available models, the *probabilistic voting* or expected vote maximization model appears well suited to deal with tax structure in a democratic setting. The probabilistic voting model starts with the idea of treating voting choices as probabilistic and by assuming that candidates maximize expected votes. The probabilistic voting framework may be characterized as follows. First, political parties or candidates are uncertain about how voters will cast their votes in the next election. Second, they view all voters, not just the median voter, as relevant, with each voter having a different probability of voting for the party or candidate. Third, parties or candidates structure their platforms and policies so as to maximize expected votes, and keep adjusting policies continually toward this objective. Fourth, voters evaluate different policies according to the utility that they will receive from the platforms, and cast their votes accordingly. Finally, voters' utility determines the voting probabilities for the party or candidate. Thus, competition for office continually pressures political actors to search for policies that ensure electoral success. This competitive process also determines the behavior of the governing party or government, which formulates tax and other policies so as to maximize the number of votes expected in the election. In such an environment, tax structure can be viewed as representing an equilibrium strategy adopted as part of a competitive political process.

Probabilistic voting is a theory of electoral competition in which politicians or candidates offer policy platforms to the voters. Probabilistic voting models essentially smooth out these objectives of vote-maximizing candidates by introducing uncertainty, from the candidates' viewpoint, about the mapping from policy to aggregate voting behavior. Most elections in democratic societies are characterized by some degree of uncertainty about what voters will do. This feature can be captured by modeling voter behavior as 'probabilistic' from the point of view of the candidates or parties. We incorporate candidate uncertainty into the unidimensional and multidimensional voting models by assuming probabilistic choices by the voters.

We, like Hettich and Winer model, focus on the modeling of political equilibrium. That is, we aim to characterize the political equilibrium of the tax policy, and interpret the political equilibrium. Moreover, their model assume that there is no tax or benefit illusion. That is, they assume that voters accurately assess their perceived tax policy. But, we extended to incorporate 'tax illusion' into our basic model, and examine the impact of tax illusion on the political costs.

A main result is that if there is an *underestimated* tax illusion, this leads to *lower* political cost than that of no tax illusion. This provides an incentive for candidates to make taxes *less visible*, or more complex. Moreover, if we incorporate the *benefit illusion* into our model, we expect the different result from the tax illusion. For instance, supposing that there is an *overestimated* benefit illusion, then the marginal political gains will be increased. Thus, each candidate will have an incentive for benefits from public services to be overestimated by voters.

According to the empirical studies on the political costs by Landon and Ryan, we can infer some implications. First, governments that want to raise their percentage of the vote are likely to reduce their reliance on *broad-based visible taxes* such as gasoline taxes or income taxes, and to concentrate on raising revenue from '*less visible revenue sources*', such as corporate taxes and user fees. Second, because there is a difference between the relative marginal economic and relative marginal political costs of particular taxes, governments are *unlikely* to choose the 'tax mix' that minimizes the economic costs of taxation.

Finally, if administrative costs and self-selection constraint are included in our model, we would expect that the actual number of tax rates and tax bases will be *smaller* than that in the model we examined. Thus, administrative costs and self-selection considerations will serve to *restrain* political optimal tax policy. We remain this for future study.

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