The Allocation of the Income Tax among Different Levels of Government: a Theoretical Solution

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Department of Public Policy and Public Choice
University of Eastern Piedmont “Amedeo Avogadro”
Via Cavour 84 – 15100 Alessandria – Italy
Phone: +39 0131 283715
Fax : +39 0131 283704
E-mail: ferruccio.ponzano@sp.unipmn.it

Abstract: The purpose of this paper is to show how two competitive governments can simultaneously choose their income taxes. There are two different levels of government in competition: a central government and a local one. The problem is analysed starting from the Leviathan hypothesis and from the theory of incomplete contracts. We assume that a government includes its re-election in its utility function and study the allocation of the income tax rates between the two levels of government, free from any legal or regulatory constraint. We show that the governments are interested in meeting the re-election constraint, but this common interest does not generate an egalitarian allocation of the tax rates.

JEL Classification: D72, H11, H21, H71, H77.
1. Introduction

The purpose of this paper is to show how two competitive governments can simultaneously choose their income taxes. There are two different levels of government in competition: a central government and a local one. The jurisdiction of the local government is a part of the jurisdiction of the central government. So, we have the same tax base for the two levels of government. The problem is illustrated starting from the Leviathan hypothesis. The Leviathan hypothesis tells us that a government maximises its tax revenue, i.e., it tries to reach the top of its Laffer (1981) curve.

Starting from this hypothesis and considering two different levels of government in competition, Flowers (1988) shows that the total tax rate—given by the sum of the tax rate chosen by the central government plus the tax rate chosen by the local government—maximising the tax revenue of each government is higher than the tax rate proposed by the Leviathan hypothesis. This occurs because the two levels of government, each maximising its own tax revenue, act like duopolists that choose their tax rate in a Cournot model. So we have a higher total tax rate and lower revenue with respect to the efficient solution—represented in this case by the Leviathan solution—where the total revenue is maximised. From the first part of the model analysed by Flowers we can easily see that the equilibrium point is on the downward sloping part of the Laffer curve.

In this paper we introduce a second variable to determine the optimal tax rate. Actually, democratic constitutions allow citizens to turn down a government if they are not satisfied. Seabright (1994), starting from the theory of incomplete contracts, assumes that a government includes its re-election in its utility function. In choosing an income tax, we must include re-election as an argument of the utility function of the government. Moreover, citizens do not accept any tax rate proposed by the government and the re-election of the government is linked to the tax rate imposed. Consequently, governments face a constraint. In particular, we assume that if a democratic government chose the tax rate suggested by the Leviathan hypothesis, we would expect voters to turn down the government.

Section 2 sets forth the hypotheses of the model. Section 3 presents the model. Section 3.1 presents a model with a single level of government to show how the government chooses between the “Leviathan” tax rate and a lower tax rate that allows re-election. In particular, we will find the optimal value of the tax rate that allows to be re-elected. Section 3.2 presents the model with two different levels of government and finds an efficient allocation of the two tax rates subject to the constraint that the two governments must be re-elected. In section 3.3, applying game theory, we try to understand the final allocation of the tax rates between local and central government. In
section 3.4 an extension of the model will be presented to account for the presence of $N$ local governments. Section 4 presents some concluding remarks and extensions.
2. Assumptions of the model

We assume the presence of two governments, a central one and a local one, that have the same tax base and the same income tax. I consider an income tax because it is well perceived by people and is not linked to any particular service. Each government is described by a utility function that depends positively on the amount of tax revenue and the probability of being re-elected.

\[ U = U(\eta G, R) \]  

where \( G \) is the amount of tax revenue of the government, \( \eta \) is a parameter \((0 < \eta < 1)\) that represents the part of the tax revenue that becomes rent for politicians and \( R \) is the benefit of being re-elected. As showed in equation (1), we do not consider all the tax revenue as a rent for the government, but we think that the amount of this revenue proportionally increases the utility of the government. Considering that the variable \( R \) is endogenous, we can maximize our utility function.

Borrowing an hypothesis used in Barro (1973) where citizens are willing to re-elect a government if it delivers a level of public expenditure \( G \) or a lower one, we assume that citizens re-elect a government if it imposes a level of income tax rate equal to or lower than \( \tau^* \).

The choice of the tax rate to build a re-election constraint is inspired by Hettich and Winer (1997). In particular, they consider that the Leviathan hypothesis represents a dictatorship. In fact, a Leviathan would be voted out of office in a democracy. Therefore they consider some other hypothesis that can be useful to build a constraint on the amount of the tax revenue. For example, they analyse the median voter’s hypothesis (Hotelling, 1929, and Downs, 1957) and the probabilistic voting approach (Enelow and Hinich, 1984, and Coughlin, 1992).

This way of reasoning is different from models that feature a “representative agent” where a benevolent government implements a tax system that maximizes the welfare of a representative citizen. This part of the literature does not consider that politicians are maximizing individuals. As argued by Breton and Ursprung (2002), we cannot consider individuals that maximize their own utility when they are employers, employees, investors or consumers and maximizing something different when they are politicians. As Adam Smith said, selfishness is the invisible hand that generates competition, also when we speak about politics.

As argued by Hettich and Winer, we will allow for separation between taxation and public expenditure, “since we believe that this best describes tax policy in democratic states”\(^1\).

\(^1\) In Hettich and Winer (1997, p.12).
Starting from different preferences of citizens about central and local policies we can examine two limit cases. In the first case, we assume that voters choose to re-elect a government without being influenced by the behaviour of the other government. Hence, in this case, voters evaluate the level of the income tax imposed by each government to decide whether to re-elect it or not. The following figure shows the results of this hypothesis where the lines $\tau_L$ and $\tau_C$ represents the limit for the tax rates to allow re-election. We have four different situations combining the choices of the two governments. If the two governments are willing to be re-elect, they maximize their own utilities in the point where $\tau_L$ meets $\tau_C$.

Figure 1

In the second case, we assume that voters do not care whether the tax rate is imposed by the central or the local government. The only thing they want is that the sum of the two tax rates not exceed the level they consider right, and this level is exogenous in our model. Different combinations of central and local taxes are indifferent to the voters as long as their sum is the same. Hence, the re-election constraint the two governments face is a downward sloping straight line with a slope equal to $-1$.

We assume, first, that central and local elections are simultaneously held and, second, given the preferences, that voters cannot divide their votes. They can only choose to confirm both governments or to turn them both down.
The probability of being re-elected, for each government, is 1 if the total tax rate is lower than or equal to $\tau^*$ and 0 if the total tax rate is higher than $\tau^*$. The central government is constrained to choose a uniform tax rate across its jurisdiction. Local and central income taxes are proportional.

The condition for being re-elected is that the sum of local and central tax rates is

$$\tau_C + \tau_L \leq \tau^*$$

Figure 2 shows the re-election constraint.

Now, we can simplify our utility function using an additive form to consider an explicit form of the utility function of governments:

$$U_i = \eta G_i + R_i$$

where $i$ represents the level of government: $L$ if the government is local and $C$ if it is central.

An example is given by the Italian situation, where the central government chooses its tax rate and local governments can choose a residual tax rate within narrow limits.
3. The model

3.1 The model with one level of government

As a first step, we now analyse our model with a single level of government that maximises its utility function. It can choose between two alternative solutions: the Leviathan tax rate without being re-elected or the highest tax rate that permits to be re-elected.

Our government has a utility function

\[ U = \eta G + R \tag{4} \]

and it is a monopolist maximising its own utility. As we said before, we posit a positive marginal utility from re-election. In particular, we assume that the value of \( R \) is 0 if the government is not re-elected and higher than 0 if the government is re-elected. Our government can choose between the Leviathan tax rate (\( \tau \)) resulting in a total income of \( \bar{Y} \) and the “re-election” tax rate (\( \tau^* \)) resulting in a total income of \( Y^* \). Obviously, given that the income tax is distortionary, \( Y^* \) is higher than \( \bar{Y} \), and, given the Leviathan hypothesis, \( \bar{Y} \tau > \tau^* Y^* \).

In this first part of the model, we calculate the value of \( R \) which makes it preferable for the government to choose the re-election strategy with a tax rate \( \tau^* \), when it faces the two alternatives presented above.

Figure 3 shows an example of a modified Laffer curve that embodies the hypotheses presented above.

If the government is not re-elected, its utility is
\[ U = \eta \tau Y \] \tag{5}

if the government is re-elected, its utility is

\[ U = \eta \tau^* Y^* + R. \] \tag{6}

In our case, if

\[ R > \eta \tau Y^* - \eta \tau^* Y^* = \eta (\tau Y - \tau^* Y^*) \] \tag{7}

the government will choose the tax rate, \( \tau^* \), that ensures its re-election.

We can easily note that equation (7) is true if and only if the value of \( R \) is higher than 0. At the same time, if we increase the value of \( \eta \) we need a higher value of \( R \) to allow that governments want the re-election. A higher possibility of corruption leads the government to maximize its rent for a single period.

### 3.2 The model with two levels of government

Next, we consider the choice of the two tax rates imposed simultaneously by the two governments. In our model the re-election of a government is influenced by the tax rate set by the other one. Furthermore, we assume that collusion is not possible and competition occurs only among different levels of government.

Following Flowers, if governments do not care about re-election \( (R = 0) \), we obtain a solution where the sum of the tax rates is higher than the “Leviathan” tax rate. In particular, with the same tax base and with zero costs of collection, the total tax rate is the same as in the Cournot model \( (\tau^0) \), and the tax rates imposed by each government are identical and equal to one half of the tax rate determined by the Cournot equilibrium \( \left( \frac{\tau^0}{2} \right) \). Total tax revenue is \( \tau^0 Y^0 \), and for each government it is \( \frac{\tau^0}{2} Y^0 \), where \( Y^0 \) is the amount of income associated to the tax rate \( \tau^0 \). Obviously, with \( \tau^0 > \bar{\tau}, Y^0 < \bar{Y} \).

As we assumed above, maximising tax revenue is not the only factor influencing the utility level of each government, because re-election is also important. In our case, the two different levels of government must implement a total tax rate lower than or equal to \( \tau^* \) if they want to be re
So, we have to find at least one allocation of the two tax rates where both governments receive a higher level of utility from re-election than in the Cournot solution.

As we have shown with a single level of government, a government chooses to be re-elected if \( R > \eta(\bar{\tau}Y - \tau^* Y^*) \). With two levels of government, we can easily see that, if both governments chose to be re-elected in the case they were the sole government, the egalitarian allocation of \( \tau^* \) between them would yield a higher utility than choosing \( \tau^0 \) and being turned down.

This implies:

\[
R > \eta(\bar{\tau}Y - \tau^* Y^*) > \eta \left( \frac{\tau^0}{2} Y^o - \tau^* Y^* \right). \quad (8)
\]

The third term of the inequality is always lower than the half of the second because \( \bar{\tau}Y \) is certainly higher than \( \tau^0 Y^o \) (the third term could be negative, but it do not change our results). Thus, the two levels of government can find at least one allocation of the tax rates, the egalitarian one, that satisfies the re-election constraint and yields higher utility levels than the Cournot solution. This allocation certainly exists when a single level of government receives a higher utility from the tax rate \( \tau^* \) and re-election than from the Leviathan tax rate and no re-election.

The next question is if there exist some other allocations that are consistent with the satisfaction of our constraint. First of all, we know that a government will choose not to exceed the constraint if \( R > \eta(\bar{\tau}Y - \tau^* Y^*) \), so one government can force the other to choose a tax rate such that:

\[
\bar{\tau}Y - \tau^* Y^* = \frac{\tau^0}{2} Y^o - \tau^* Y^*. \quad (9)
\]

Solving the equation for \( \beta \), after some calculation we obtain

\[
\beta = \frac{1}{\frac{\tau^0}{2} Y^o + \frac{\bar{\tau}Y - \tau^* Y^*}{\tau^* Y^*}}. \quad (10)
\]

where, starting from equation (8) and (9) the value of \( \beta \) is higher than 2 if:
\[
\frac{\tau^o}{2}Y^o - \frac{\tau^*}{\beta}Y^* > 0
\] (11)

Let us assume that disequation (11) holds in our case (if it is not the case the value of \(\beta\) is negative).

Obviously, this holds for both governments, and therefore each government will want to secure the highest share of the tax rate, being sure that the other government will not react because it would suffer a loss in utility.

We conclude that an infinite number of efficient allocations could be found on the line \(\tau^*\tau^*\) in figure 2.

We can now examine some solutions with the aid of game theory.

3.3 Choice of the optimal tax rates

From the preceding part of the model, we note that, for each government, the best solution is securing the highest tax rate for itself (higher than \(\frac{\tau^*}{2}\) and equal to \(\frac{\beta}{\beta-1}\tau^*\)) while the other government sets \(\frac{\tau^*}{\beta}\), the second – best solution is represented by the tax rate \(\frac{\tau^*}{2}\), the third-best is the tax rate \(\frac{\tau^*}{\beta}\) (lower than \(\frac{\tau^*}{2}\)) associated with the re – election. The worst solution is setting a tax rate \(\frac{\tau^o}{2}\) without being re – elected.

Let us now assign a payoff of 4 to the first best solution, 3 to the second best, 2 to the third best and 1 to the worst. Assume that both governments have two kinds of behaviour at their disposal, an aggressive behaviour and a yielding one. If both governments opt for a yielding behaviour, each obtains a tax rate equal to \(\frac{\tau^*}{2}\) and is re-elected, while if they both behave aggressively, each will end up with a tax rate \(\frac{\tau^o}{2}\) and will not be re – elected. If the two governments behave in different ways, the aggressive one secures a tax rate higher than \(\frac{\tau^*}{2}\) associated with re – election while the yielding one ends up with the tax rate \(\frac{\tau^*}{\beta}\), also associated with the re – election.

The matrix of the payoffs is as follows. It is a reminiscent of a chicken game.
If we analyse the table, we can detect two Nash equilibria: the first where the central government behaves aggressively and the local one yields (4;2), and the second where the central government yields and the local one behaves aggressively (2;4). This shows that the egalitarian allocation will not be chosen, but each government will want to increase its share of the tax revenue, leaving the other with the residual share \( \frac{\tau^*Y^*}{\beta} \). This occurs because an increase in the tax rate set by one government forces the other government to reduce its tax rate. In terms of game theory, responding to an aggressive behaviour by one government with an aggressive behaviour by the other is considered a non-credible threat.

Our model does not determine which government will set the highest tax rate and which will set the tax rate \( \frac{\tau^*}{\beta} \). In our model, the only answer is that the first government that behaves aggressively will achieve the first best solution, and the other will get the tax rate \( \frac{\tau^*}{\beta} \), which represents the third-best solution.

We now examine an extension to the model, increasing the number of local governments from 1 to \( N \).

### 3.4 The model with a central government and \( N \) local governments

Consider \( N \) local governments sharing the jurisdiction of the central government. We assume that there is no competition among governments at the same level. This allows local governments to set different tax rates without losing taxpayers through mobility, unlike in the Tiebout (1956) hypothesis.

The first question is how the allocation of the tax rates among central and local governments will develop. If the central government decides to move first and decides to behave aggressively, each local government must put up with the aggressive behaviour of the central government and...
accept the tax rate $\frac{\tau^*}{\beta}$. In the same way, if all the local governments decide to behave aggressively at the same time and before the central government, the central government must accept the tax rate $\frac{\tau^*}{\beta}$.

In the real world, we can easily note that the first case is more common than the second, because it only requires a choice by an individual agent and not a coordinated choice by a relatively high number of agents.

Borrowing an assumption of Seabright’s model, the re-election of a local government depends exclusively on the choice of the voters of the jurisdiction concerned. Re-election of the central government, however, does not require a favourable vote by any one jurisdiction, but in a way that varies according to different electoral systems. It requires that $n < N$ localities vote its re-election. If the number $n$ is big enough, a central government can easily stop the action of one or few local governments behaving aggressively by itself resorting to an aggressive strategy.

We can better analyse the situation. Let us start from a position where central and local governments behave yieldingly. Suppose now that a local government decides to behave aggressively. Then, the best response for the central government is to behave aggressively. As a consequence the local government would be voted out of office while the central government would not (if $n > 1$), and the other local governments would have to suffer the latter’s aggressive behaviour without any possibility of reaction. So, unless we assume a perfect co-ordination among local governments, which is very difficult to establish (for example, it is very difficult to co-ordinate two local governments governed by different political parties), the central government enjoys an advantage over the local governments in the choice of the tax rate. We can say that the Nash equilibrium where the central government behaves aggressively and local governments yield is the most likely, under the hypothesis of $N$ local governments.

In fact if we write the extensive form of the game, we can easily see that the only subgame perfect Nash Equilibrium is represented by the aggressive behaviour of the central government and the yielding behaviour of the local ones.
From a purely theoretical point of view, we can think that local governments move simultaneously. In this case we come back to the situation represented in table 1 with two Nash equilibria. We obtain two stable solutions but we don’t know how to reach one of them instead of the other. So, we can introduce further conditions.
Let us consider the presence of two political parties. They run for the government of the state and of the $n$ localities. If the party that does not control the state controls a small number of localities, as they cannot behave as a *pivot*, the central government can easily bag the lion’s share of tax revenue. In particular, if the party that governs the state behaves as a fully rational individual, it maximizes its rent by applying the highest tax rate at the central level and zero taxes at the local one, obtaining the re-election. In this case, the local governments where the state minority rules can apply the tax rate that maximizes the rent for the current period and lose the following election.

As we noted above, the first mover has always an advantage with respect to the second one. Now, we relax the hypothesis of simultaneous elections. Going back to our game, we can easily note that the government in office can move first and bag the lion’s share of the tax revenue. But, in this case, the question arises: when did the first election occur? In fact, our game has a unique S. P. N. E. if we have a starting point. We need a special event that occurs in the history of a country. In particular, we can argue that, in a unitary state that is dividing into regions, the central government will have an advantage in securing the lion’s share of the tax revenue. In the same way, if a group of states decides to become a federation, local governments will have an advantage. We do not have a unique solution, as in the case of simultaneous elections, if we have a relevant institutional change (a new Constitution, for example) without having an assignment of powers and functions among the different levels of government.
4. Conclusions

In this paper I set out to explain what happens when two different levels of government can impose the same tax on the same tax base. We have studied the allocation of the tax rates on a purely economic basis. No regulations are admitted in our model and the behaviour of one government cannot legally be influenced by the other. In particular, the central government cannot influence local governments, as happens in a lot of real cases.

Starting from some studies that rely on the Leviathan hypothesis, we suggested adding the argument of re-election to the utility functions of governments. After determining the critical level of $R$ when there exists a single level of government, we showed that, if we add a second level of government, governments could be interested in meeting the re-election constraint. This common interest does not generate an egalitarian allocation of the tax rate, and in equilibrium one of the two levels of governments secures a larger share of the tax revenue than the other does. If we consider a number of jurisdictions greater than 1, then the central government could have an advantage in securing the lion’s share of the tax revenue, as it does not have to incur the transaction costs that local governments face to co-ordinate their behaviour.

In further research we will focus on the possibility of an endogenous $R$ (the utility of being re-elected), different preferences in different jurisdictions and progressive income taxes.
5. References


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