FISCAL DECENTRALIZATION AND FISCAL DISCIPLINE

A Master's Thesis

by

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Ankara

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To My Family and Yusuf Işık

FISCAL DECENTRALIZATION AND FISCAL DISCIPLINE

The Institute of Economics and Social Sciences
of
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by

NİDA ÇAKIR

In Partial Fulfillment of the Requirements for the Degree
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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics

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ABSTRACT

FISCAL DECENTRALIZATION AND FISCAL DISCIPLINE

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September 2006

In this thesis, the effects of fiscal procedures, fiscal centralization and fiscal decentralization, on fiscal discipline are analyzed in a theoretical framework. A model of two optimization problems is established: central government's optimization problem and local government's optimization problem representing the two fiscal procedures; fiscal centralization and fiscal decentralization respectively. Comparative static analysis is performed, and moreover ambiguous results are calibrated. Our results indicate that in fiscal decentralization fiscal discipline increases with the number of localities. Furthermore, the portion that goes to the pool of the central government has a positive effect on the size of redistribution in fiscal centralization, but it has a negative effect in fiscal decentralization. Similarly, whereas income tax rate affects the size of redistribution positively in fiscal centralization, it has a negative effect in fiscal decentralization.

Keywords: Fiscal Decentralization, Fiscal Discipline

ÖZET

MALİ YERELLEŞME VE MALİ DİSİPLİN

Çakır, Nida

Yüksek Lisans, İktisat Bölümü
Tez Danışmanı: Yrd. Doç. Dr. Bilin Neyaptı

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Bu tezde, mali usullerin, mali yerelleşme ve merkezileşme, mali disiplin üzerine etkileri teorik bir çerçevede incelenmiştir. Mali yerelleşme ve merkezileşmeyi sırasıyla temsil eden yerel hükümet eniyileme ve merkezi hükümet eniyileme problemlerini içeren bir model kurulmuştur. Karşılaştırmalı statik yapılmış ve ayrıca belirsiz sonuçlar kalibre edilmiştir. Sonuçlara göre, mali yerelleşmede, yerel hükümetlerin sayısı arttıkça mali disiplin artmıştır. Buna ilaveten, merkezi hükümetin havuzuna giden oran arttıkça, mali merkezileşmede toplam transfer miktarı artarken, mali yerelleşmede toplam transfer miktarı oran artışıyla azalmıştır. Benzer şekilde, mali merkezileşmede gelir vergisi oranı toplam transferler üzerinde pozitif bir etki yaratırken, mali yerelleşmede bu oran toplam transferler üzerinde negatif bir etki yaratmıştır.

Anahtar Kelimeler: Mali Yerelleşme, Mali Disiplin

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CHAPTER 1

INTRODUCTION

Government deficits are a matter of concern in most of the countries, developing or developed, for which reducing budget deficits by means of achieving fiscal discipline is an important phenomenon. Accordingly, in recent years, a growing number of countries around the world have increased efforts to improve on fiscal organizations, where fiscal decentralization (FD) is one aspect of these organizations.

Main issues that fiscal organizations or arrangements take into account are as follows:

- **i.** How should the central and local government relationships be established?
- **ii.** Does the transfer system create negative incentives for localities to collect taxes?
- **iii.** How should intergovernmental transfers be structured so as to ensure fiscal discipline?

It can be deducted from the above questions that the structure of transfer systems is crucial, and the decisions of governments should be in such a way that they are able to reduce fiscal indiscipline, and income disparities.

An important aspect of fiscal arrangements, fiscal decentralization refers to devolution of revenue sources and expenditure functions to lower tiers of government. Accountability and transparency in government actions, streamlining public sector activities and encouraging the development of local democratic traditions (De Mello, 2000) carry important implications for the success of FD. Since the main goal of FD is to achieve lower budget deficits, the effect of fiscal decentralization on fiscal discipline is important.

There is a growing recent theoretical literature on fiscal arrangements and fiscal discipline, as well as optimal equalization grants. For instance, Von Hagen and Harden (1995) examine decision making procedures and fiscal discipline in a game theoretical framework. They take into consideration the budgeting procedures within the central government concerning the collective interest of the government and individual interest of spending ministers (SMs), and conclude that procedure oriented approach, that is the decision of SMs, leads to lower fiscal discipline.

Neyaptı (2006, forthcoming) addresses fiscal discipline via fiscal decentralization by means of extending the model of Von Hagen and Harden (1995) such that the effects of monetary discipline on budgetary outcomes can be examined. Unlike Von Hagen and Harden (1995) would predict, Neyaptı shows that, due to the addition of central bank independence feature into the model, one can obtain the result that as the number of SMs increases, total spending and deficits may decrease. Moreover, the higher the utility obtained from SMs' individual spending, the higher are the spending biases and budget deficits.

In an analysis of the effects of different intergovernmental regimes on fiscal discipline, Sanguinetti and Tommasi (2004) argue that fiscal indiscipline results from the optimization problem of the locality under incomplete information. Slightly different from the above studies, Dahlby and Wilson (1994) focus on equalization grants in the context of optimal tax theory. Optimal equalization grants are formulated so as to distribute the tax burden across localities, and the authors conclude that when the share of total expenditures of a locality exceeds the share of total capacity, it is a recipient of grant.

This study offers a theoretical framework where we focus on the effects of fiscal procedures, i.e. fiscal decentralization and centralization, on fiscal discipline[1]. In a way, we compare the fiscal procedures with regards to fiscal discipline. In doing this we also address the issue of equalization, where we construct the fiscal procedures of fiscal centralization and fiscal decentralization as

[1] Fiscal discipline is taken as aggregate tax effort.

the optimization problems of the central government and local government, respectively. The set up of our model includes a redistribution mechanism that depends on the tax effort and the deviation of the actual income from the target income of a locality. Moreover, fiscal discipline is measured via tax efforts resulting from the optimization problems. Hence, while focusing mainly on fiscal discipline by means of fiscal procedures; we address equalization and total transfers, i.e. size of redistribution, under a redistribution mechanism. The equalization concept here is referred to as the setting of target incomes across localities at the same level.

Different from the mentioned literature, fiscal procedures described in the current model, which yields the optimal tax effort and optimal transfers, are constrained by a redistribution mechanism which includes a measure of fiscal discipline as well as equalization. While maximizing the welfare of the society, a block mechanism preventing overspending of jurisdictions is formed. As a result, our study focuses on the issues i to iii mentioned above. Main findings of our analysis are as follows:

i. In fiscal decentralization procedure, the number of localities is positively associated with fiscal discipline.

ii. In the procedure of fiscal decentralization, an increase in the deviation of actual output from its target creates a disincentive for a locality to increase its tax effort due to increase in transfers via this deviation of income.

iii. In the procedure of fiscal decentralization, the portion that goes to the pool of the central government has a negative effect on the size of redistribution, however in fiscal centralization a positive effect is observed.

iv. The income tax rate has a positive effect on the size of redistribution in fiscal centralization, but in fiscal decentralization it affects the size of redistribution negatively.

The remaining part of the study is organized as follows. Chapter 2 presents a literature survey on fiscal arrangements and fiscal discipline as well as equalization. Chapter 3 presents our model and solutions of our optimization problems. Chapter 4 provides comparative static analysis. Chapter 5 submits the calibrated results obtained in the chapters 3 and 4. Finally, Chapter 6 concludes.

CHAPTER 2

LITERATURE SURVEY

Provision of economic efficiency and macroeconomic stability are among the main concerns of the governments. In this context, fiscal arrangements are crucial. The range of fiscal activities subject to such fiscal organizations includes the decisions on taxes, intergovernmental transfers, and debt financing, all of which have attracted a good deal of attention in the literature. Fiscal decentralization is one aspect of fiscal arrangement that the literature has widely focused on.

Many empirical studies have recently examined the advantages and or the pitfalls of fiscal decentralization. De Mello (2000) states that local governments meet local preferences and needs better than national governments. Since local governments are much closer to the people and so more identified with local causes, information on the local preferences and needs costs cheaper reducing transaction costs. Hence, fiscal decentralization (FD) is expected to boost public sector efficiency, accountability, and transparency. But, on the other hand, De Mello

(2000) also emphasizes that fiscal relations is a crucial and rather complex issue in decentralization, and failures in coordination of intergovernmental relations can result in a deficit bias, especially in the case of developing countries. It has been expressed that possible higher coordination and information costs to jurisdictions may prevent the realization of benefits of decentralization, and hence expenditure decentralization may worsen the situation.

Fiscal decentralization has two aspects: expenditure and revenue-collection decentralization of the governments. Decentralization of spending may increase economic efficiency which may imply lower deficits, but an increase in deficits is also possible. Within this frame, Neyaptı (2006) analyzes the relationship between budget deficits and fiscal decentralization using panel data techniques. Whereas expenditure decentralization is observed to be significant for deficits, revenue decentralization is not. The analysis focuses on various factors that are suggested to affect the relationship between FD and deficits by the literature. The factors are as follows: the size of the government, business cycles, governance, size of the country, the presence of local elections, and the extent of ethno linguistic fractionalization.

Related to the factors that are analyzed by Neyaptı (2006), Davoodi (1998) shows the negative impact of FD on growth for developing countries based on the argument that the efficiency gains from FD may not materialize for developing countries since revenue collection and expenditure decisions by local governments may still be constrained by the central government.[2] Similarly, Zou and Jin (2002) examine the effects of decentralization on government size. They conclude that expenditure decentralization leads to larger aggregate and sub national governments. However, revenue decentralization leads to larger sub national governments but it reduces national government's size by more than it increases sub national governments' sizes, and hence leads to a smaller aggregate government size.

There are also theoretical studies inspecting the structure of procedures for choices of the federal government and its jurisdictions, and the structure of transfer systems. Within this context, Sanguinetti and Tommasi (2004) analyze the effects of different regimes of intergovernmental transfers on fiscal discipline and welfare. Analogous to our model, the model of Sanguinetti and Tommasi (2004) enables us to observe whether certain institutional arrangements weaken fiscal discipline or not. Furthermore, the paper determines the level of transfers in different institutional settings, and different from us, the authors consider the role of transfers on smoothing shocks to local incomes. Federal transfers are used as a risk sharing mechanism, and they finance expenditures of localities via stochastic

[2] Neyaptı (2006) expresses that growth, which stands for business cycles, also affects deficits.

income by the federal government. In the paper, in one regime, local income in each region is realized by the federal government, and via the optimization problem the federal government precommits to a certain level of transfers (called as the first best case). The set up is similar to the central government's optimization problem in our model. While transfers compensate for both horizontal and vertical imbalances in Sanguinetti and Tommasi (2004), transfers compensate only for horizontal imbalances in our case and there is no ex-ante insurance. In our set up, central government does not collect taxes, localities collect taxes and a portion of the collection goes to the pool of the central government.

Sanguinetti and Tommasi (2004) study also incomplete information with two cases: commitment and Nash. In the commitment case, federal government commits to a certain level of transfers knowing just the distribution of shocks, not the realization. In the latter, each locality maximizes its utility similar to the local government's optimization problem in our model. They conclude that transfers and private consumption are higher than the first best case. Hence, incomplete information yields excessive sub-national spending. In this context, the effort related compensation mechanism which works as a punishment mechanism in the redistribution rule of transfers in our model may be considered as a block mechanism that prevents overspending.

Another important finding, which is also related to our analysis, of Sanguinetti and Tommasi (2004) is that in the Nash solution too little tax effort is observed when the resources of the federal government are not fixed and distortionary taxation is considered. Similarly, in our set up, under same income targets across two localities, the local government's optimization problem yields lower total tax efforts than that of the central government implying lower fiscal discipline.

Dahlby and Wilson (1994) also elaborate equalization grants but in the framework of optimal tax theory. As in Sanguinetti and Tommasi (2004), they minimize the social cost of providing government services, which is equivalent to maximizing the welfare of the society, where they relate equalization grants to tax effort and fiscal capacity. A similar relation is invigilated in our analysis that focuses on the distribution of tax burden across localities, where the grants are made. Even though the distribution of transfers according to a rule maximizing the welfare of the society is an analogous concept, we do not study optimal taxation. Differently, we focus on the fiscal procedures (centralization versus decentralization), where the decision of optimal tax effort that maximizes the welfare is made by the locality.

In Dahlby and Wilson (1994), an optimal equalization grant formula is examined which has expenditure and fiscal capacity mechanisms, and the equalization payments sum up to zero. This implies that the federal government takes from one locality and gives it to the other. Our redistribution rule of transfers similarly includes tax effort and income compensation mechanisms; however, all the collection is allocated back to the jurisdictions, so that they do not sum up to zero. Moreover, Dahlby and Wilson (1994) construct the formula such that if the share of total expenditures of a locality exceeds the share of total fiscal capacity, it is a recipient of grant; which can be sighted in our analysis as we compensate a locality for lower actual income than the target income[3].

While Dahlby and Wilson (1994) focus on how the tax burden in a federation should be distributed across jurisdictions so that equalization of the social marginal cost of raising revenue across localities via optimal grants is satisfied, Sanguinetti and Tommasi (2004) focus on different fiscal regimes of intergovernmental transfers and fiscal discipline. We, on the other hand, present a model that unify some aspects of both Sanguinetti & Tommasi (2004) and Dahlby & Wilson (1994) such that we elaborate both different fiscal procedures and optimal grants in a framework that allows us to address fiscal decentralization and fiscal discipline, as well as equalization.

[3] Another equalization grant mechanism based on population is also considered by the authors. But, this does not yield optimal values and it is deducted that the resulting grants may reduce welfare.

Similar to Sanguinetti & Tommasi (2004), Von Hagen and Harden (1995) analyze how decision making procedures can be used as devices for fiscal discipline and affect fiscal performance of a government. The authors analyze fiscal discipline under a different set up, however. They consider the budgeting procedures within the central government describing different fiscal procedures concerning the collective interest of the government and individual interest of spending ministers (SMs). Moreover, the paper focuses on fiscal illusion that is described as the overestimation of the marginal benefit of a public activity. The optimization problem of the government yields smaller optimal budget than the resulting budget of the SMs' optimization problem implying a spending bias due to fiscal illusion. Lower spending bias can be interpreted as ensuring fiscal discipline. Within this context, we can conclude that fiscal decentralization results in fiscal indiscipline in Von Hagen and Harden (1995), which is parallel to our finding considering FD and fiscal discipline under equalization in a slightly different model. Similarly, Sanguinetti & Tommasi (2004) concludes that, under incomplete information, excessive sub national spending is observed. But, additionally, Von Hagen and Harden (1995) examine the case where SMs negotiate over the allocations, and a smaller optimal budget is obtained. So, they conclude that bargaining reduces the spending bias; which is equalization that reduces fiscal indiscipline in fiscal decentralization of our analysis. As a result, Von Hagen and

Harden (1995) state that strengthening the collective interest the government can reduce the spending bias, which could be achieved via vesting the ministers without portfolio with special strategic powers. Modeling this approach indicates that when the ministers without portfolio have little strategic power, the optimal budget gets closer to the bargaining optimal budget of the SMs. However, when they have full strategic power, the collective optimal budget is reached. Hence, the paper observes a positive relation between spending bias and the relative strength of SMs' individual incentives against collective interest of the government.

A unifying theme of Von Hagen & Harden (1995) and Neyaptı (2006) is fiscal discipline which is addressed via budgeting procedures in the former and fiscal decentralization in the latter. Moreover, Neyaptı (2006, forthcoming) extends the model of Von Hagen & Harden (1995) such that the effects of not only fiscal discipline but also monetary discipline on budgetary outcomes can be inspected. Neyaptı (2006, forthcoming) incorporates central bank independence (CBI) as a measure of monetary discipline and a budget constraint into the model of Von Hagen & Harden (1995). Different from Von Hagen & Harden (1995), deficits are financed through money issue inversely related with the degree of CBI and through bond issue, and all monetary expansion is inflationary. Moreover, model predictions are tested empirically for 12 OECD countries during the 1980s. The results support the model results. The results are such that if the central bank is totally independent, all SMs' spending are on target and inflation is zero. Otherwise, there is a negative relationship between the deviations of spending and inflation from their respective targets. When the central bank is not totally independent, Nash bargaining solution leads to lower spending bias than the individual optimization of SMs.

Consistent with Von Hagen & Harden (1995), Neyaptı (2006, forthcoming) observes that the government's collective interest yields lower budget deficits, and lower inflation rates than the SMs' individual and Nash bargaining solutions. She also states that the lack of monetary discipline increases fiscal discipline on the part of spending ministers, since the model imposes that they internalize the cost of their spending. Hence, as the number of the SMs (n) increases, the government may cut back on total spending and deficits due to the expectation that both total spending and inflation would increase. Two other important findings of Neyaptı (2006, forthcoming) are as follows: the first is that as n increases, the spending bias that arises from Nash bargaining solution increases as compared to that of the government's collective interest. That is, increase in the number of localities leads to lower fiscal discipline in the Nash bargaining case than the government's collective interest. The second is that the higher the utility received from individual SMs' spending, the higher are the spending biases and budget deficits, implying lower fiscal discipline. Even though, we can not do a comparison between our procedures with respect to a change in n, in our model, as the number of localities increases, higher fiscal discipline is provided under fiscal decentralization. Contrary to the second finding, calibration analysis of fiscal decentralization procedure concludes that the higher the utility obtained from government expenditures the higher the fiscal discipline.

Neyaptı (2005) examines fiscal decentralization under a different set up from the above theoretical studies. Like Dahlby and Wilson (1994), the paper focuses on equalization but, in the frame of fiscal decentralization using regression analysis considering the provinces of Turkey. In the paper, in addition to the main concerns for FD, main issues that affect the success of FD are mentioned. It is stated that equality, macroeconomic stability, and economic efficiency are among the main issues of FD. Eliminating vertical imbalances along with reducing horizontal imbalances is the “equalization” concept of the paper. Moreover, the paper realizes equalization feature as a disciplining device in case of FD. Our model considers equalization as an additional crucial issue to be analyzed along with the fiscal procedure of decentralization, while focusing mainly on the provision of fiscal discipline. Similar to Dahlby and Wilson (1994) and our study, the paper proposes a redistribution method for Turkey based on the measures of vertical and horizontal imbalances across the jurisdictions, where our redistribution mechanism only considers horizontal imbalances based on a theoretical set up. As also told by Dahlby and Wilson (1994), Neyaptı (2005) states that focusing only on a population based system of distribution of the revenue pool is not meaningful. An egalitarian redistribution system can be better. Then, she concludes that the better the macroeconomic performance, the larger the municipal revenues, and the better the socio-economic status, the larger the municipal spending. In addition, the paper deducts that a reasonable system of redistribution should be based on socio-economic characteristics.

In summary, fiscal decentralization has important implications for economic efficiency. While FD can be promoted due to provision of more identified local causes and cheaper costs of information on the local preferences and needs, it can also lead to excessive sub national spending, high budget deficits, lower tax efforts, and so lower fiscal discipline. Hence, exploring the design of fiscal decentralization along with its impact on fiscal discipline and equalization still remains to be an important issue.

CHAPTER 3

MODEL

Consider an economy where there are n local governments and a central government. Governments' main objective is to maximize the welfare of the society. The central government (CG) collects taxes from each locality. "c" proportion, where $0 < c < 1$, of all collected taxes goes to the pool of the central government, all of which is then allocated back to the regions as transfers. Moreover, we assume that only local governments undertake government spending in a locality and CG has no spending.

Local governments (LGs) collect effective income taxes and make expenditures that are financed by part of the tax collection that does not go to the pool of the CG (c portion of the tax collection goes to the pool) plus the transfers. Allocation of transfers to each locality is based on a redistribution rule which is composed of a punishment mechanism and an income compensation mechanism. The punishment mechanism depends on the deviation of tax effort of the locality from the target value "1", and the income compensation mechanism refers to the transfers compensation based on the deviation of actual output of the locality from its target output. In our model, the deviations of actual output of the localities from their target output indicate horizontal imbalances. As this deviation increases, imbalance grows. Hence, to be able to compensate the imbalance, transfers should rise. Therefore, one part of the redistribution rule works as an income compensation mechanism. So, the tax effort of the locality and the deviation of actual output from the target are crucial for the transfers a locality receives.

We are going to analyze two fiscal procedures represented by the central government's and the local governments' optimization problems[4]. CG decides on the level of transfers allocated to each locality while maximizing the overall welfare of the society subject to the collection constraint. The optimization problem of CG is referred to as *"fiscal centralization"*. On the other hand, LG maximizes the welfare of its jurisdiction subject to the redistribution rule and decides on the level of its tax effort. We refer to LG's optimization as *"fiscal decentralization"*.

Tax effort level is important in analyzing fiscal discipline. We characterize *"fiscal discipline"* in each problem as the total of tax efforts across the local governments. Furthermore, the optimal level of total transfers is characterized as *"the size of redistribution"* in each problem. The main objective of studying

[4] We also studied the problems when either CG or LG is the leader. Because of the set ups of the CG and LG problems (and their constraints), the leader problems do not give meaningful results. So, only the two main problems (CG and LG) are analyzed in this paper.

these two procedures is to be able to answer the question: "Does fiscal decentralization cause more fiscal discipline?". Hence, we aim to evaluate the two different fiscal procedures (CG and LG problems that represent fiscal centralization and decentralization respectively) on the basis of fiscal discipline they lead to; that is we compare the two problems vis a vis both fiscal discipline and also the size of redistribution. Therefore, the evaluation of our results depends on total tax efforts and total transfers implied by the two problems. Based on these results, comparative static analyses are utilized in the next chapter for studying the effects of the main parameters of the model on fiscal discipline and the size of redistribution.

In the following section, first we describe the common expressions and variables of the two problems. Then, we study the problems and solutions separately in sections 3.2 and 3.3.

3.1 Variables and Description of the Model

We assume that there are n localities which are indexed by i=1, 2,…, n.

The effective tax rate of the Central Government is defined as $t_i = tA_i$ where t is the exogenous common income tax rate and A_i is the tax effort of the ith locality, where $0 < t < 1$ and $0 < A_i \leq 1$[5] .

[5] Distribution depends on local governments' tax efforts and the deviation of actual output from target output. To avoid from corner solution (zero tax effort) in the LG problem and to create a

$Y_i = f(K_i, L_i)$ is the per capita production of locality i (actual output), which is exogenous with given K_i, L_i per capita capital and per capita labor amounts for each locality[6].

$T_i = t_i Y_i$ is the effective income tax of region i.

$c\sum_{i=1}^{n} T_i$ is the total revenue of the Central Government, where c is the proportion of effective local taxes that is given to CG[7].

Y_i^* is the exogenously determined target level of output of locality i.

$C_i = Y_i - T_i = (1-t_i)Y_i = (1-tA_i)Y_i$ is the private consumption which is the after tax income, where we assume $C_i > 1$. It is therefore observed that C_i is a decreasing function of A_i.

Local government expenditures are composed of transfers received from the central government (TR_i) and the part of the effective income tax revenue that

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redistribution mechanism, we limit the level of tax efforts as $0 < A_i \leq 1$ where "1" is the target value.

[6] All variables are in per capita terms.

[7] $c\sum_{i=1}^{n} T_i = ct\sum_{i=1}^{n} A_i Y_i > 0$

does not go to the pool of the central government. That is, $G_i = TR_i + (1-c)t_iY_i$ is the government expenditure of the ith locality. We also assume that $G_i > 1$[8].

It can be observed that the market clearance condition is satisfied for the CG problem: $\sum_{i=1}^{n} Y_i = \sum_{i=1}^{n} (C_i + G_i)$. It is, however not the case for the LG problem, since $Y_i = C_i + G_i$ does not necessarily hold so long as $TR_i \neq ctA_iY_i$, meaning that transfers are not necessarily equal to locality's contribution to the common pool

Transfers are distributed according to the following redistribution mechanism that has both a punishment and a compensation components to achieve discipline and income equality:

$$TR_i = k(t_i - t) + m(Y_i^* - Y_i) \qquad (3.1)$$

where k is the "punishment parameter" or the effort related compensation parameter ($k > 0$, a policy variable), and m is the "income compensation parameter" or the weight on the income compensation, where $0 < m < 1$. The first part of the rule, $kt(A_i - 1)$, works as a punishment mechanism such that the lower the tax effort of the ith locality the lower the transfer given to it. Therefore, transfers are designed to generate incentives for localities to provide tax effort, since they are

[8] In the following section, we construct the problems such that the governments get utility from private consumption and government expenditures, where the utility is a concave function of C_i and G_i. Within this frame, to have well defined problems the specified assumptions, C_i>1 and G_i>1, are made.

given according to provided tax effort. On the other hand, the second part, $m(Y_i^* - Y_i)$, works as an income compensation mechanism such that the lower the deviation of actual output of the ith locality from target, the lower the transfers it receives so that equality across regions can be reached[9]. Hence, the central government's transfers are used for both income compensation and provision of fiscal discipline. From (3.1) one can observe that a locality can receive zero transfers when A_i is "1" and income is on target. Furthermore, the rule works completely as a punishment mechanism for a locality having a high level of output as compared to the target even if full tax effort ("1") is provided. This is due to the fact that $Y_i^* - Y_i$ decreases as Y_i increases, and CG can compensate the horizontal imbalances by means of transfers when the actual output of the locality is less than the target.

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[9] In our model the target output of the ith locality is indicated by Y_i^* and it is exogenous.

If $Y_i^* = Y^*$ for all i, the income compensation mechanism turns out to be an "*equalization mechanism*". That is, setting all the targets at the same level is "*equalization*".

Alternatively, the target output can be defined as $Y_i^* = g(K_i, L_i)$ and $Y_i = Y_i^* + \varepsilon_i$, where ε_i is a random shock. We may also consider a production function that is the same for all localities, but there are different endowments and different shocks. If $\left(\sum_{i=1}^{n}(Y_i^* - Y_i)\right) > 0$, then $\left(\sum_{i=1}^{n}\varepsilon_i\right) < 0$ is obtained. This means that a locality can receive transfers in case of negative shocks, like the "*income compensation*" mechanism.

We also consider the case where $Y_i^* = \overline{Y}$, but it causes the income compensation part of the redistribution rule to disappear and the size of the redistribution to be non positive which contradicts with our model set up.

For both problems, preferences are defined over private consumption and government expenditures. The problems are discussed in detail in the following sections, 3.2 and 3.3.

3.2 Local Government's Problem[10]

The utility function of the ith locality is defined as

$$U_i = \alpha \ln C_i + \beta \ln G_i \qquad (3.2)$$

where U_i is concave and increasing in both C_i and G_i, and $\frac{\partial^2 U_i}{\partial G_i \partial C_i} \geq 0$.

Moreover,

U_i satisfies the Inada conditions. That is, $\lim_{C_i \to 0} \frac{\partial U_i}{\partial C_i} = \infty$ and $\lim_{G_i \to 0} \frac{\partial U_i}{\partial G_i} = \infty$.

(3.2) shows that a locality gets utility from private consumption and government expenditures in proportions of α, $0 < \alpha < 1$, and β, $0 < \beta < 1$, respectively[11].

The optimization problem of LG is defined as the maximization of the welfare of the locality subject to the redistribution mechanism:

[10] We study the problem of Local Government for an arbitrary locality because the problem is same for other localities.

[11] In the following calibrations, we use the standard form of Cobb Douglas function such that $\alpha + \beta = 1$.

$$\underset{A_i}{\text{maximize}} \quad U_i = \alpha \ln C_i + \beta \ln G_i \qquad (3.3)$$

$$\textit{subject to} \quad TR_i = kt(A_i - 1) + m(Y_i^* - Y_i) \quad (3.1)$$

To solve the problem, we first replace C_i by $(1-t_i)Y_i$ and G_i by $TR_i + (1-c)t_iY_i$ in (3.3), which yields:

$$\begin{aligned} &\max_{A_i} \; \alpha \ln((1\text{-}tA_i)Y_i) + \beta \ln(TR_i + (1-c)tA_iY_i) \\ &s.to \; TR_i = kt(A_i - 1) + m(Y_i^* - Y_i) \end{aligned}$$

As can be observed, if transfers increases, government expenditures increases which in turn increases the utility.

Now, to convert the problem into an unconstrained optimization problem, we insert (3.1) into the objective function. Then, we have

$$\max_{A_i} \; V_i = (\alpha \ln((1\text{-}tA_i)Y_i) + \beta \ln(kt(A_i - 1) + m(Y_i^* - Y_i) + (1-c)tA_iY_i)) \qquad (3.4)$$

Our solution to this problem should satisfy the first order and second order optimality conditions. The first order condition of the problem is

$$\frac{\partial(\alpha \ln((1\text{-}tA_i)Y_i) + \beta \ln(kt(A_i - 1) + m(Y_i^* - Y_i) + (1-c)tA_iY_i))}{\partial A_i} = 0 \quad (3.5)$$

and it results in

$$A_i^o = \frac{\alpha(kt - m(Y_i^* - Y_i))}{t(\alpha+\beta)(k + (1-c)Y_i)} + \frac{\beta}{t(\alpha+\beta)} \qquad (3.6)$$

A_i^o characterizes the optimal A_i obtained as the solution of the problem if it also satisfies the second order optimality condition. The second order optimality condition is described as $\dfrac{\partial^2 V_i}{\partial A_i^{\,2}} \le 0$ at A_i^o.

$$\frac{\partial^2 V_i}{\partial A_i^{\,2}} = -\frac{t^2\alpha}{(1-tA_i)^2} - \frac{(kt+(1-c)tY_i)^2\beta}{(kt(A_i-1)+(1-c)tA_iY_i+m(Y_i^*-Y_i))^2} \qquad (3.7)$$

When we evaluate (3.7) at A_i^o, we have the following:

$$-\frac{t^2(k+(1-c)Y_i)^2(\alpha+\beta)^3}{\alpha\beta(k(t-1)+(c+m-1)Y_i-mY_i^*)^2} \le 0\,.$$

Hence, the second order optimality condition is also satisfied. Therefore, A_i^o is the optimal tax effort for the LG problem[12].

From (3.6), we obtain the total optimal tax efforts of the LGs as:

$$\sum_{i=1}^{n} A_i^o = \sum_{i=1}^{n}\left(\frac{\alpha(kt-m(Y_i^*-Y_i))}{t(\alpha+\beta)(k+(1-c)Y_i)} + \frac{\beta}{t(\alpha+\beta)}\right) \qquad (3.8)$$

which is the expression for fiscal discipline in fiscal decentralization. Given (3.1), we also observe that

$$\sum_{i=1}^{n} TR_i = \sum_{i=1}^{n}(kt(A_i-1)+m(Y_i^*-Y_i)) \qquad (3.9)$$

Inserting (3.6) into (3.9) results in

[12] See appendix for details about nonzero optimal solution.

$$TR = \sum_{i=1}^{n} TR_i = \sum_{i=1}^{n} m(Y_i^* - Y_i) + \frac{k\alpha}{\alpha+\beta}\sum_{i=1}^{n}\left(\frac{kt - m(Y_i^* - Y_i)}{k + (1-c)Y_i}\right) + nk\left(\frac{\beta}{\alpha+\beta} - t\right) \quad (3.10)$$

Therefore, (3.10) is the optimal size of redistribution for the LG problem.

3.3 Central Government's Problem

The utility function of CG (U) is defined as the sum of the utilities of all regions:

$$U = \sum_{i=1}^{n} U_i = \sum_{i=1}^{n} (\alpha \ln C_i + \beta \ln G_i) \quad (3.11)$$

The optimization problem of CG is

$$\underset{\mathrm{TR_i}}{\max}\text{imize} \sum_{i=1}^{n} (\alpha \ln C_i + \beta \ln G_i) \quad (3.12)$$

$$\text{subject to} \quad \sum_{i=1}^{n} TR_i = \sum_{i=1}^{n} (ctA_i Y_i) \quad (3.13)$$

The problem specifies that overall welfare of the society is to be maximized while all the taxes collected, $\sum_{i=1}^{n} (ctA_i Y_i) > 0$, are distributed back to regions as transfers.

Now, we proceed with the solution of the problem. The Lagrangean function is:

$$L = \sum_{i=1}^{n}(\alpha \ln C_i + \beta \ln G_i) + \lambda(\sum_{i=1}^{n} ctA_iY_i - \sum_{i=1}^{n} TR_i)$$

where λ is the Lagrange multiplier. The value of the Lagrange multiplier at the solution of the problem is equal to the rate of change in the maximal value of the objective function as the constraint is relaxed. As in LG problem we replace C_i by $(1-t_i)Y_i$ and G_i by $TR_i + (1-c)t_iY_i$, and obtain the first order conditions as:

$$\frac{\partial L}{\partial TR_i} = \frac{\beta}{TR_i + (1-c)tA_iY_i} - \lambda = 0 \qquad (3.14)$$

$$\frac{\partial L}{\partial \lambda} = \sum_{i=1}^{n} ctA_iY_i - \sum_{i=1}^{n} TR_i = 0 \qquad (3.15)$$

Combining (3.14) and (3.15) yields:

$$TR_i^o = \frac{t}{n}\left(\sum_{i=1}^{n} A_iY_i\right) - (1-c)tA_iY_i \qquad (3.16)$$

(3.16) should also satisfy the second order necessary conditions to be the optimal solution to the CG problem.

To examine the 2nd order necessary conditions, we are going to check the rank of $\partial_{TR_i}\left(\sum_{i=1}^{n} TR_i - \sum_{i=1}^{n} ctA_iY_i = 0\right)$, and second order derivative of the Lagrangean of the CG problem with respect to TR_i at TR_i^o.

$Rank\left(\partial_{TR_i}\left(\sum_{i=1}^{n} TR_i - \sum_{i=1}^{n} ctA_iY_i = 0\right)\right) = Rank(1) = 1$. Moreover, $\partial^2{}_{TR_i}(L) = \dfrac{-\beta}{((1-c)t_iY_i + TR_i)^2} < 0$ at TR_i^o. Hence, the rank equals to the number of constraints and second order derivative of the Lagrangean function is negative implying that the second order optimality condition is met. Therefore, (3.16) is the optimal solution to the CG problem. According to (3.16), one can observe that transfer distribution of the central government depends basically on the tax effort and actual income of jurisdiction. Moreover, the total size of redistribution of the problem is given by:

$$TR = \sum_{i=1}^{n} TR_i = \sum_{i=1}^{n}\left(\frac{t}{n}\left(\sum_{i=1}^{n} A_iY_i\right) - (1-c)tA_iY_i\right) = ct\sum_{i=1}^{n} A_iY_i .$$

In the next chapter, we do comparative static analysis for A_i, TR_i, and TR arising from both problems with respect to main parameters.

CHAPTER 4

COMPARATIVE STATIC ANALYSIS

In order to examine the relationship between fiscal decentralization and fiscal discipline we need to perform comparative static analysis. To this end, we are going to study partial derivatives of the size of redistribution, optimal level of transfers and tax effort with respect to:

$$c,\ k,\ m,\ t,\ n,\ \alpha,\ \beta,\ (Y_i^* - Y_i)$$

for both the CG and the LG problems. In addition, we will inspect how transfers change with respect to a change in the tax effort. We think that this analysis will enable us to make judgements about the effectiveness of different fiscal procedures, where effectiveness is with respect to fiscal discipline and the elimination of horizontal imbalances.

4.1 Comparative Statics for LG problem

The effects of the specified variables on the optimal tax efforts and the size of redistribution are analyzed in the following subsections 4.1.1 and 4.1.2 respectively.

4.1.2 Partial Derivatives for Optimal Tax Effort

We use the expression that we have obtained in the LG problem:

$$A_i = \frac{\alpha(kt - m(Y_i^* - Y_i))}{t(\alpha+\beta)(k+(1-c)Y_i)} + \frac{\beta}{t(\alpha+\beta)} \qquad (3.6) \quad \text{i=1,.., n.}$$

whose partial derivative with respect to the portion of taxes (c) that goes to the pool of the central government is:

$$\frac{\partial A_i}{\partial c} = -\frac{\beta Y_i}{t(k+Y_i-cY_i)(\alpha+\beta)} + \frac{Y_i((kt+m(Y_i-Y_i^*))\alpha+(k+Y_i-cY_i)\beta)}{t(k+Y_i-cY_i)^2(\alpha+\beta)} \qquad (4.1)$$

The sign of (4.1) cannot be determined. In cases of ambiguous signs, we utilize calibration analysis as will be reported in the next chapter.

Equation (4.2) shows how tax effort responds to a change in the effort related compensation parameter:

$$\frac{\partial A_i}{\partial k} = \frac{t\alpha+\beta}{t(k+Y_i-cY_i)(\alpha+\beta)} - \frac{(kt+m(Y_i-Y_i^*))\alpha+(k+Y_i-cY_i)\beta}{t(k+Y_i-cY_i)^2(\alpha+\beta)} \qquad (4.2)$$

If $(Y_i^* - Y_i) > 0$, tax effort increases with the effort related compensation. According to the redistribution rule, income compensation increases the transfers received. This creates an incentive for a locality to increase its tax effort via effort related compensation.

The partial with respect to the income compensation parameter yields:

$$\frac{\partial A_i}{\partial m} = \frac{\alpha(Y_i - Y_i^*)}{t(\alpha+\beta)(k + Y_i - cY_i)} \qquad (4.3)$$

According to (4.3), if actual output is higher than the target, as the rate of income related compensation increases tax effort of locality i increases. That is, $\frac{\partial A_i}{\partial m} > 0$.

One explanation is that, TR will decrease if $Y_i > Y_i^*$. So, to be able to compensate this decrease in transfers, local government should increase its tax effort. On the other hand, if actual output is lower than the target, as m increases tax effort decreases. That is, TR will increase if $Y_i < Y_i^*$ (income compensation mechanism). So, there will be no need to increase A_i for the locality to increase transfers. Therefore, high TR may create a disincentive for tax effort.

The effect of common income tax rate on tax effort is given by:

$$\frac{\partial A_i}{\partial t} = \frac{k\alpha}{t(k + Y_i - cY_i)(\alpha+\beta)} - \frac{(kt + m(Y_i - Y_i^*))\alpha + (k + Y_i - cY_i)\beta}{t^2(k + Y_i - cY_i)(\alpha+\beta)} \qquad (4.4)$$

Similarly, we are not able to observe the sign of (4.4). Calibration will tell us the sign.

As the deviation of the actual income from its target increases, tax effort of the i[th] locality decreases:

$$\frac{\partial A_i}{\partial (Y_i^* - Y_i)} = -\frac{\alpha m}{t(k + Y_i - cY_i)(\alpha + \beta)} \qquad (4.5)$$

This is due to increasing transfers via the increase in $(Y_i^* - Y_i)$, which creates a disincentive for the locality to increase its tax effort.

The effect of the proportion of private consumption in utility on tax effort is also ambiguous:

$$\frac{\partial A_i}{\partial \alpha} = \frac{kt + m(Y_i - Y_i^*)}{t(k + Y_i - cY_i)(\alpha + \beta)} - \frac{(kt + m(Y_i - Y_i^*))\alpha + (k + Y_i - cY_i)\beta}{t(k + Y_i - cY_i)(\alpha + \beta)^2} \qquad (4.6)$$

Similar to the above, the effect of the utility proportion of government expenditure on tax effort is ambiguous:

$$\frac{\partial A_i}{\partial \beta} = \frac{1}{t(\alpha + \beta)} - \frac{(kt + m(Y_i - Y_i^*))\alpha + (k + Y_i - cY_i)\beta}{t(k + Y_i - cY_i)(\alpha + \beta)^2} \qquad (4.7)$$

Calibration will show us the sign of these effects.

As we can observe from (3.6), we are not able to examine the effect of the number of jurisdictions on the optimal tax effort. However, we can observe the effect of n on fiscal discipline, $\frac{\partial\left(\sum_{i=1}^{n} A_i\right)}{n} = \frac{\beta}{t(\alpha+\beta)} > 0$. Hence, the following proposition arises:

Proposition 1: The number of the local governments has a positive effect on fiscal discipline.

A locality should provide tax effort to get transfers from the central government. Hence, an increase in number of localities may result in an increase in total tax efforts.

4.1.2. Partial Derivatives for the Size of Redistribution

Expression for the size of redistribution for LG problem from section 3 is:

$$TR = \sum_{i=1}^{n} TR_i = \sum_{i=1}^{n} m(Y_i^* - Y_i) + \frac{k\alpha}{\alpha+\beta}\sum_{i=1}^{n}\left(\frac{kt - m(Y_i^* - Y_i)}{k+(1-c)Y_i}\right) + nk\left(\frac{\beta}{\alpha+\beta} - t\right) \tag{3.10}$$

The effect of the proportion that goes to the pool of CG on the size of redistribution depends on $\sum_{i=1}^{n}\left(Y_i(Y_i - Y_i^*)\right)$:

$$\frac{\partial TR}{\partial c} = kt\sum_{i=1}^{n}\left(-\frac{\beta Y_i}{t(\alpha+\beta)(k+Y_i-cY_i)} + \frac{Y_i(\beta(k+Y_i-cY_i)+\alpha(kt+m(Y_i-Y_i^*)))}{t(\alpha+\beta)(k+Y_i-cY_i)^2}\right) \tag{4.8}$$

If $\sum_{i=1}^{n}\left(Y_i^2 - Y_i Y_i^*\right) > 0$, as c increases the size of redistribution increases.

Similarly, the effect of the punishment rate on the size of redistribution is uncertain:

$$\frac{\partial TR}{\partial k} = -nt + kt\sum_{i=1}^{n}\left(\frac{t\alpha+\beta}{t(\alpha+\beta)(k+Y_i-cY_i)} - \frac{\beta(k+Y_i-cY_i)+\alpha(kt+m(Y_i-Y_i^*))}{t(\alpha+\beta)(k+Y_i-cY_i)^2}\right)+$$
$$t\sum_{i=1}^{n}\left(\frac{\beta(k+Y_i-cY_i)+\alpha(kt+m(Y_i-Y_i^*))}{t(\alpha+\beta)(k+Y_i-cY_i)}\right) \tag{4.9}$$

The effect of income compensation rate on the size of redistribution is also ambiguous:

$$\frac{\partial TR}{\partial m} = -\sum_{i=1}^{n}(Y_i-Y_i^*) + kt\sum_{i=1}^{n}\left(\frac{\alpha(Y_i-Y_i^*)}{t(\alpha+\beta)(k+Y_i-cY_i)}\right) \tag{4.10}$$

The effect of the tax rate on the size of redistribution is also ambiguous, and the calibration will provide a more definite answer:

$$\frac{\partial TR}{\partial t} = -nk + kt\sum_{i=1}^{n}\left(\frac{k\alpha}{t(\alpha+\beta)(k+Y_i-cY_i)} - \frac{\beta(k+Y_i-cY_i)+\alpha(kt+m(Y_i-Y_i^*))}{t^2(\alpha+\beta)(k+Y_i-cY_i)}\right)+$$
$$k\sum_{i=1}^{n}\left(\frac{\beta(k+Y_i-cY_i)+\alpha(kt+m(Y_i-Y_i^*))}{t(\alpha+\beta)(k+Y_i-cY_i)}\right) \tag{4.11}$$

The above partial derivative depends on whether $-nk + \frac{k^2\alpha}{\alpha+\beta}\sum_{i=1}^{n}\left(\frac{1}{k+(1-c)Y_i}\right)$ is positive or negative.

Similarly, the response of the size of redistribution to a change in the proportion of private consumption in utility is indefinite:

$$\frac{\partial TR}{\partial \alpha} = kt\sum_{i=1}^{n}\left(\frac{kt + m(Y_i - Y_i^*)}{t(\alpha+\beta)(k+Y_i - cY_i)} - \frac{\beta(k+Y_i - cY_i) + \alpha(kt + m(Y_i - Y_i^*))}{t(\alpha+\beta)^2(k+Y_i - cY_i)}\right) \quad (4.12)$$

The derivative of TR with respect to β is given by:

$$\frac{\partial TR}{\partial \beta} = kt\sum_{i=1}^{n}\left(\frac{1}{t(\alpha+\beta)} - \frac{\beta(k+Y_i - cY_i) + \alpha(kt + m(Y_i - Y_i^*))}{t(\alpha+\beta)^2(k+Y_i - cY_i)}\right) \quad (4.13)$$

The sign of (4.13) depends on whether $\sum_{i=1}^{n}\frac{\alpha m(Y_i^* - Y_i)}{t(\alpha+\beta)^2(k+Y_i - cY_i)}>0$ dominates the remaining part of the equation or not, which poses ambiguity. If it is dominant, as the proportion of government expenditures in utility increases, the size of redistribution increases. Otherwise, utility proportion of government expenditures affects the size of redistribution negatively.

The effect of number of localities on the size of redistribution:

$$\frac{\partial TR}{\partial n} = k\left(\frac{\beta}{\alpha+\beta} - t\right) \quad (4.14)$$

depends on $\left(\frac{\beta}{\alpha+\beta} - t\right)$. That is, if the ratio of gain from government expenditures to total gain from government expenditures and private consumption is larger than the common income tax rate, the number of localities affects the size of redistribution positively. This describes *"fiscal illusion"*: when the ratio of the net benefit from government expenditures to the net benefit from all expenditures is greater than the marginal cost to the locality, an overestimation of marginal benefit of an activity results. If this happens, then as n increases, the size of redistribution increases. Hence, fiscal illusion leads to increasing size of redistribution via fiscal decentralization.

As the deviation of target output from actual output of a locality increases, the size of redistribution increases:

$$\frac{\partial TR}{\partial (Y_i^* - Y_i)} = m\left(1 - \frac{k\alpha}{(\alpha+\beta)(k+Y_i-cY_i)}\right) \quad (4.15)$$

According to the redistribution rule, as the deviation increases, transfers received from CG increases, which is for the compensation of horizontal imbalances.

The implications of all these findings will be given after obtaining unambiguous results via calibration.

4.2 Comparative Statics for CG Problem

In this section we are going to study the effects of $c,\ t,\ n,\ k,\ m,\ Y_i,\ A_i$ on the optimal level of transfers given by CG and the size of redistribution respectively.

4.2.1 Partial Derivatives for Optimal Transfers Received by Locality i

The optimal transfers received by locality i has been given by (3.16) in section 3 as:

$$TR_i = \frac{t}{n}\left(\sum_{i=1}^{n} A_i Y_i\right) - (1-c)tA_i Y_i \quad \text{i=1, .., n.}$$

The partial derivative of TR_i with respect to the portion that goes to the pool of CG is:

$$\frac{\partial TR_i}{\partial c} = tA_i Y_i \quad (4.16)$$

which indicates that the transfers received by i[th] locality increases as c increases.

The income compensation parameter has no effect on distributed transfers:

$$\frac{\partial TR_i}{\partial m} = 0 \qquad (4.17)$$

Similarly, the effort related compensation parameter has no effect on transfers:

$$\frac{\partial TR_i}{\partial k} = 0 \qquad (4.18)$$

The effect of common income tax rate on transfers is given by:

$$\frac{\partial TR_i}{\partial t} = -(1-c)A_i Y_i + \frac{\sum_{i=1}^{n} A_i Y_i}{n} \qquad (4.19)$$

The common income tax rate affects transfers negatively if $(1-c)A_i Y_i > \frac{\sum_{i=1}^{n} A_i Y_i}{n}$, and positively if $(1-c)A_iY_i < \frac{\sum_{i=1}^{n} A_iY_i}{n}$. Actually, as the common income tax rate increases, one may expect optimal transfers given to a locality to increase, because the collection of CG, which is then totally allocated to the regions, increases. But, on the other hand, an increase in t may create a disincentive for the locality's tax effort, which may decrease the collection of CG and hence may cause a reduction in allocated optimal transfers.

The partial derivative with respect to tax effort:

$$\frac{\partial TR_i}{\partial A_i} = -(1-c)tY_i + \frac{t\sum_{i=1}^{n} Y_i}{n} \qquad (4.20)$$

The effect of tax effort on transfers received by the locality depends on whether $-(1-c)tY_i$ dominates $\frac{t\sum_{i=1}^{n} A_iY_i}{n}$ or not. If actual incomes of localities are near in value and n is large enough, most probably tax effort of the locality has a negative impact on the transfers received. We will have a concrete result by means of calibration in the next chapter.

As the number of localities increases, the optimal level of transfers given to a locality decreases:

$$\frac{\partial TR_i}{\partial n} = -\frac{t}{n^2}\sum_{i=1}^{n} A_i Y_i \qquad (4.21)$$

Although the increase in number of localities may increase the total collection of CG, it may not increase the optimal transfers received by a locality as we observe in (4.21), most probably due to the fact that the increase is not enough to increase the distributed transfers to a locality.

The deviation of actual income of a locality from its target has no effect on the optimal transfers received by the locality. But, TR_i includes the term Y_i, so we examine the effect of actual income on transfers.

$$\frac{\partial TR_i}{\partial Y_i} = \frac{t}{n} A_i - (1-c)tA_i \qquad (4.22)$$

The impact of actual income on transfers depends on $\left(\frac{1}{n} - (1-c)\right)$, hence it is ambiguous.

4.2.2 Partial Derivatives for the Size of Redistribution

The optimal size of redistribution is:

$$TR = \sum_{i=1}^{n} TR_i = \sum_{i=1}^{n} ctA_i Y_i \ .$$

The partial derivative with respect to c is given by:

$$\frac{\partial TR}{\partial c} = \sum_{i=1}^{n} tA_i Y_i \qquad (4.23)$$

The size of the redistribution obviously increases as the portion that goes to the pool of CG increases.

The effects of the punishment rate, income compensation rate, and deviation of actual output from target output on the size of redistribution are:

$$\frac{\partial TR}{\partial k} = 0 \quad \frac{\partial TR}{\partial m} = 0 \quad \frac{\partial TR}{\partial (Y_i^* - Y_i)} = 0 \qquad (4.24)$$

As the common income tax rate increases, collection of CG increases, which in turn increases the size of redistribution, since CG allocates all of its collection:

$$\frac{\partial TR}{\partial t} = c\sum_{i=1}^{n} A_i Y_i \qquad (4.25)$$

The number of localities has no effect on size of redistribution:

$$\frac{\partial TR}{\partial n} = 0 \qquad (4.26)$$

The size of redistribution increases with the tax effort of a locality:

$$\frac{\partial TR}{\partial A_i} = ct\sum_{i=1}^{n} Y_i \qquad (4.27)$$

Collection increases as the tax effort of a locality increases and hence the size of redistribution increases.

The size of redistribution also increases with the actual income of a locality:

$$\frac{\partial TR}{\partial Y_i} = ct\sum_{i=1}^{n} A_i \tag{4.28}$$

The collection increases as the income of a locality increases which in turn increases the size of redistribution.

Hence, the main unambiguous findings of the comparative static analysis are:

For the LG Problem: $\frac{\partial A_i}{\partial (Y_i^* - Y_i)} < 0,\ \frac{\partial TR}{\partial (Y_i^* - Y_i)} > 0$

For the CG Problem: $\frac{\partial TR_i}{\partial c} > 0,\ \frac{\partial TR_i}{\partial n} < 0,\ \frac{\partial TR_i}{\partial m} = 0,\ \frac{\partial TR}{\partial k} = 0,\ \frac{\partial TR_i}{\partial (Y_i^* - Y_i)} = 0$

$$\frac{\partial TR}{\partial c} > 0,\ \frac{\partial TR}{\partial t} > 0,\ \frac{\partial TR}{\partial A_i} > 0,\ \frac{\partial TR}{\partial Y_i} > 0,\ \frac{\partial TR}{\partial m} = 0,\ \frac{\partial TR}{\partial k} = 0,\ \frac{\partial TR}{\partial (Y_i^* - Y_i)} = 0,\ \frac{\partial TR}{\partial n} = 0$$

Based on the above results, the following proposition arises:

Proposition 2: In the procedure of fiscal decentralization, an increase in the deviation of actual output from its target creates a disincentive for a locality to increase its tax effort due to increase in transfers via the deviation. (See equation (4.5))

In the following chapter, we are going to calibrate the model.

CHAPTER 5

CALIBRATION ANALYSIS

To address the issue of fiscal discipline issue by means of comparative static analysis, and to obtain concrete and more definite results about our model, we utilize calibration method, where Mathematica is used for the method. To do the analysis, first of all we assign numbers to the parameters of our model. We term the assigned values to the parameters as *"calibration values"*. These values are assigned so as to: i. satisfy all the assumptions of both the CG and LG problems, and ii. be consistent with empirical studies. Then, we calibrate the solutions of our optimization problems, and analyze comparative static results in a parameter interval with assigned values for the remaining parameters, all of which satisfy i and ii.

We do the calibration analysis for two localities for simplicity (i.e. n=2). We compare the calibrated total level of transfers (TR), and total tax efforts

$\left(\sum_{i=1}^{n} A_i\right)$ for both the CG and LG problems to adjudge on the size of redistribution and fiscal discipline provided in each procedure.

Calibration values should satisfy the following:

i. $0 < c < 1$

ii. $0 < t < 1$

iii. $0 < m < 1$, k>0

iv. $0 < \alpha < 1$, $0<\beta<1$

v. $0 < A_i \leq 1$

vi. $C_i = (1 - tA_i)Y_i > 1$

vii. $G_i = TR_i + (1-c)tA_iY_i > 1$

viii. In CG problem: $\sum_{i=1}^{n} ctA_iY_i = \sum_{i=1}^{n} TR_i > 0$.

ix. In LG problem[13]: $t\alpha \neq -\dfrac{t(k+(1-c)Y_i)\beta}{(kt+m(Y_i - Y_i^*))}$, and $0 < (\alpha kt - \alpha m(Y_i^* - Y_i) + \beta(k + (1-c)Y_i)) \leq 1$

The following two sets of calibration values (I and II) satisfying the assumptions i to ix are used in this chapter:

[13] As proved in the appendix, to avoid "zero" solution and to satisfy $0 < A_i \leq 1$ in the LG problem, the inequalities have to be assumed.

I.

$$\alpha = 0.65,\ \beta = 0.35,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10,$$
$$Y_1^* = 10,\ Y_2 = 20,\ Y_2^* = 25,\ 0 < k \le 0.1$$

II.

$$\alpha = 0.65,\ \beta = 0.35,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10,$$
$$Y_1^* = 18,\ Y_2 = 20,\ Y_2^* = 18,\ 0 < k \le 0.1$$

where set I and set II differ in Y_i^* (i=1,2) only.

Evaluation is made in the interval $0 < k \le 0.1$ as we thought that the punishment parameter could be at most 1% of any assigned actual output[14]. We consider different target output values in two sets to be able to study *"equalization across localities"*. In the first set, first locality's actual output is on target, whereas the second's is under the target, and both targets are different. On the other hand, in the second set, target outputs are the same for both localities implying setting the two outputs to the same level due to equalization purpose. The proportion of private consumption in utility is assumed to be higher than that of government expenditures. 0.1 of total taxes collected from localities is supposed to go to the pool of CG. Common income tax rate is 0.5 which is indeed high. But, to be able to satisfy the assumptions of our model, we have to assign a high value to t.

[14] We are not able to benefit from an available empirical result for k.

Calibration chapter is composed of three sections; where sections 5.1 and 5.2 present the evaluations of the LG and CG problems respectively, and section 5.3 gives a comparison of fiscal procedures.

5.1 Evaluation of the LG Problem

The optimization problem of LG is studied under the calibrations of different income targets and equal income targets respectively in the subsections 5.1.1 and 5.1.2.

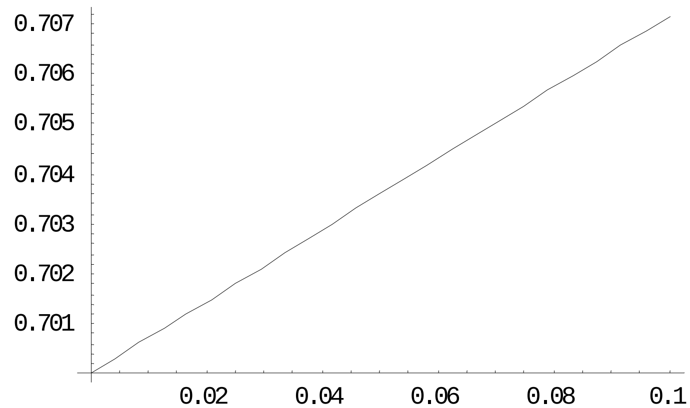
5.1.1 Different Income Targets (Set I)

In this subsection, we do our analysis for the first set of values of parameters (set I).

The optimal tax effort of the LG problem derived in section 3 (equation (3.6)) is calibrated for two localities. The graph for optimal A_1 on the vertical axis and with k, $0 < k \leq 1$, on the horizontal axis is obtained[15]:

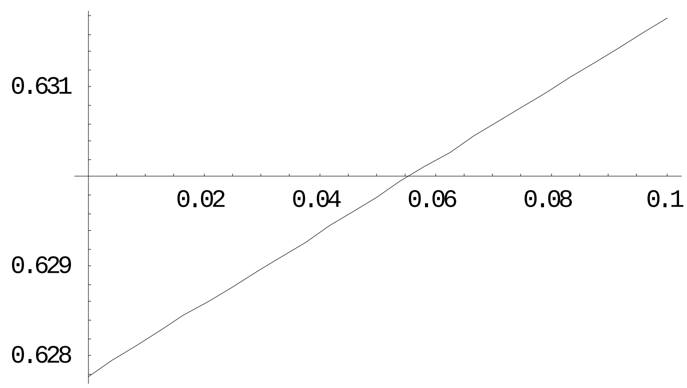
[15] In all the graphs in sections 5.1 and 5.2, tax efforts and transfers are indicated on the vertical axis and k on the horizontal axis, where $0 < k \leq 1$.

Figure 1: A_1 versus k



Similarly, for optimal A_2 we obtain:

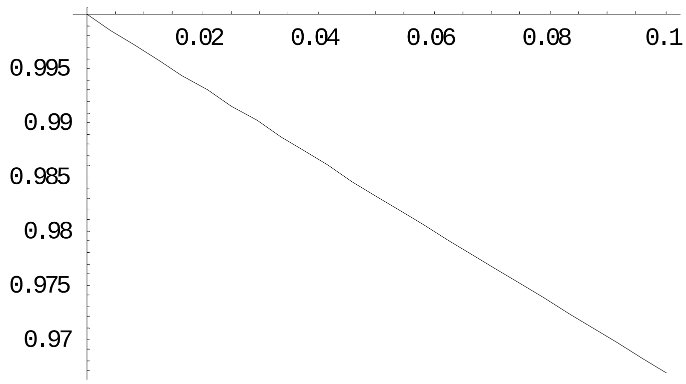
Figure 2: A_2 versus k



As can be observed, optimal tax efforts increase with the rate of effort related compensation.

The optimal size of redistribution is calibrated according to the equation (3.10), which yields the following size of redistribution graph:

Figure 3: TR versus k



The graph shows that the size of redistribution decreases with the rate of effort related compensation. This is due to the optimal tax efforts' being below the level of full tax effort.

Furthermore, inserting equation (3.6) into equation (3.1) results in the optimal level of transfers available to locality i. So, for the two localities, 1 and 2, we have the following graphs respectively:

Figure 4: TR_1 versus k

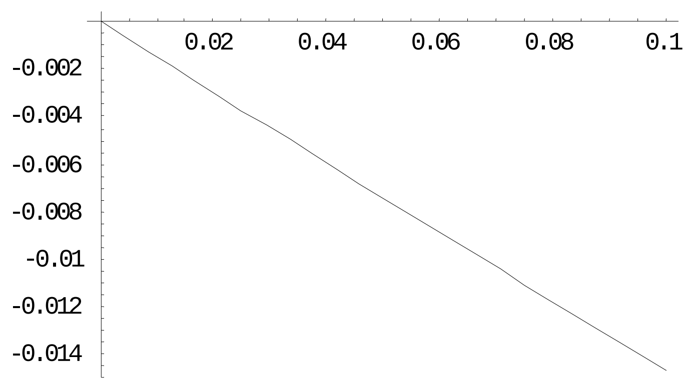


Figure 5: TR_2 versus k

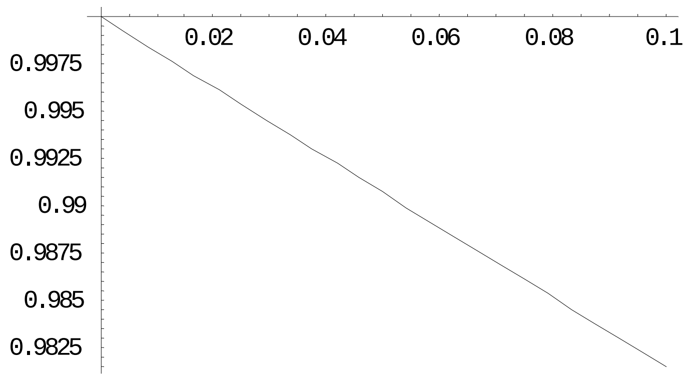


Figure 4 is the distributed transfers to locality 1 that yields from LG optimization problem, and Figure 5 is the one for the second locality. As can be observed, total of the two transfers equals to the size of redistribution (Figure 3), and while the second locality receives transfers, the first is punished. These results are due to the first jurisdiction's actual income's being on its target, the second being below the target, and both jurisdictions' lack of full tax effort.

Most part of the comparative static analysis reported in section 4 has yielded ambiguous results. Calibration of comparative static analysis now helps us to be more definite about consequences of our model. In table 1, we report the results of the calibration of the LG problem's solution and comparative static analysis with set I. The table allows us to do comparison for each set of parameters and for both procedures easily. The values reported in the first row of table 1 are taken from the figures 1 to 5.

Table 1: Calibration of the LG Problem with different target incomes

LG PROBLEM

Y_1=10, Y_1*=10, Y_2=20, Y_2*=25, k=0.1

A_1	A_2	TR_1	TR_2	total TR	Total A_i
0,707	0,632	-0,014	0,9822	0,966	1,342

dTR/ dc	dk	dm	dt	dn	dalpha	dbeta	d(Y_1*-Y_1)	d(Y_2*-Y_2)
-0,0032	-0,325	49,824	-0,2	-0,05	-0,07	0,13	0,1986	0,1993

d(TR_1)/ dc	dk	dm	dt	dn	dalpha	dbeta
0,0004	-0,143	0	-0,1	NA[1][16]	-0,035	0,064

d(TR_2)/ dc	dk	dm	dt	dn	dalpha	dbeta
-0,0037	-0,182	49,825	-0,1	NA	-0,035	0,07

dA_1/ dc	dk	dm	dt	dalpha	dbeta	d(Y_1*-Y_1)	d(Y_2*-Y_2)
0,008	0,0708	0	-1,4	-0,696	1,293	-0,0286	0

dA_2/ dc	dk	dm	dt	dalpha	dbeta	d(Y_1*-Y_1)	d(Y_2*-Y_2)
-0,076	0,0397	-0,359	-12,568	-0,7368	1,368	0	-0,01436

According to the calibration table, while the effect of the income compensation parameter on A_1 is zero, the effect on A_2 is negative. The

[16] NA: Not Available, which stands for unobserved derivatives

explanation is that, the first jurisdiction's actual income is on target so that m has no impact. However, the second locality's actual income is below the target causing transfers to increase via m, which in turn decreases the tax effort. Therefore, the income compensation parameter affects the size of redistribution positively.

As the common income tax rate increases, the tax efforts of both jurisdictions decrease. As a result, the size of redistribution decreases.

While the utility proportion of government expenditures affects the tax efforts positively, the effect of the private consumption proportion in utility is negative. Hence, α has negative and β has positive impacts on the size of redistribution.

As the portion that goes to the pool of CG increases, the tax effort of locality 1 increases whereas the second's decreases. Most probably, the negative effect generated by the 2nd locality on the tax effort is dominant over the positive effect generated by the other, so that c affects the size of redistribution negatively.

As the number of jurisdictions increases, the size of redistribution decreases. According to equation (4.14), overestimation of marginal cost may cause the negative effect of n on TR.

5.1.2 Equal Income Targets (Set II)

To examine the concept of *"equalization"* more clearly, we evaluate our procedure at

$$\alpha = 0.65,\ \beta = 0.35,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10,$$
$$Y_1^* = 18,\ Y_2 = 20,\ Y_2^* = 18,\ 0 < k \le 0.1$$

Graphs of the optimal tax efforts for localities are respectively as follows:

Figure 6: A_1 versus k

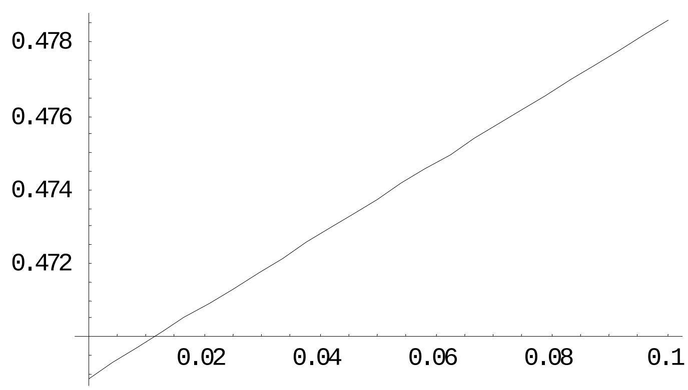
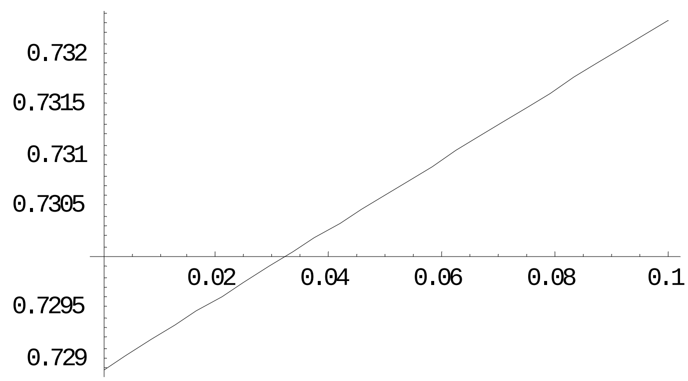
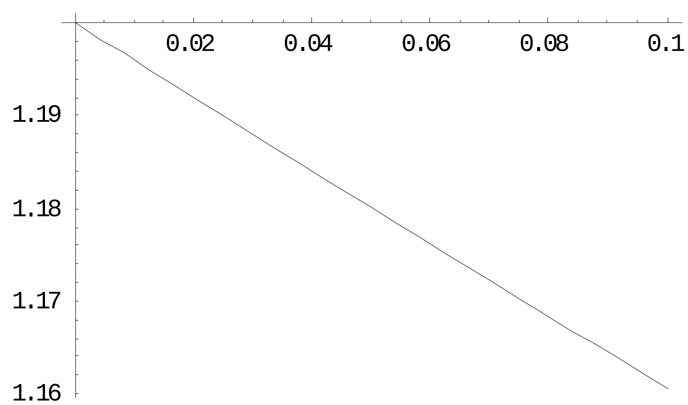


Figure 7: A_2 versus k



The graphs indicate that the optimal tax efforts increase as k increases.

Figure 8: TR versus k



The size of redistribution decreases as the punishment parameter increases. The reason is that both jurisdictions are lack of full tax effort.

Graphs for distributed transfers to the jurisdictions 1 and 2 are respectively:

Figure 9: TR_1 versus k

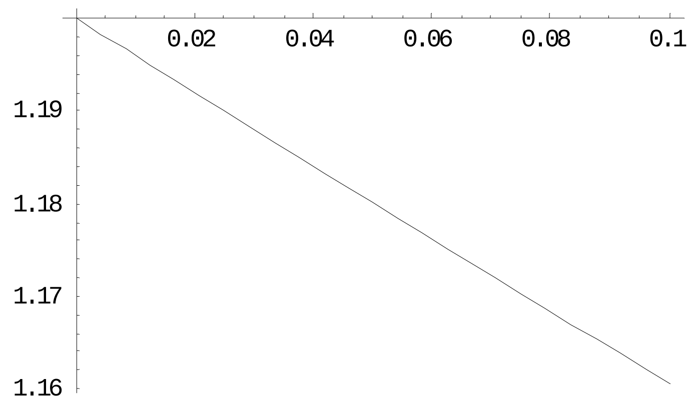
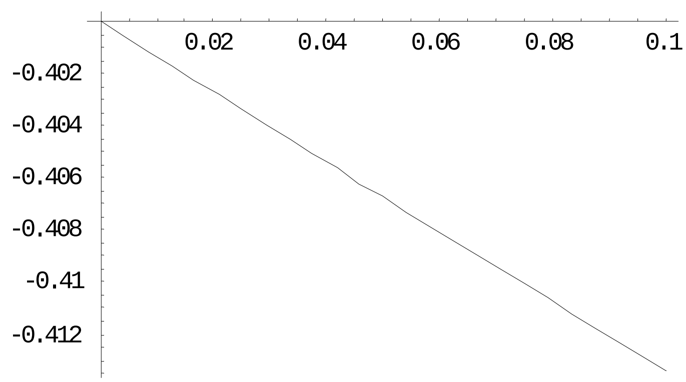


Figure 10: TR_2 versus k



The optimal transfers distributed to localities 1 and 2 decrease as the punishment parameter increases. Local government 1 receives transfers, whereas local government 2 is punished. Negative transfer (i.e. punishment) is due to lack of full tax effort and higher actual income than the target.

Table 2 reports the corresponding calibrated optimal tax efforts, distributed transfers to each local government, the size of redistribution, and comparative static results.

Table 2 Calibration of the LG problem under equalization

LG PROBLEM

Y_1=10, Y_1*=18, Y_2=20, Y_2*=18, k=0.1

A_1	A_2	TR_1	TR_2	total TR	Total A_i
0,4782	0,7322	1,575	-0,413	1,16	1,2104

dTR/

dc	dk	dm	dt	dn	dalpha	dbeta	$d(Y_1^*-Y_1)$	$d(Y_2^*-Y_2)$
-0,001	-0,388	5,95	-0,2	-0,05	-0,07	0,14	0,1986	0,1993

$d(TR_1)$/

dc	dk	dm	dt	dn	dalpha	dbeta
-0,012	-0,256	7,95	-0,1	NA	-0,04	0,064

$d(TR_2)$/

dc	dk	dm	dt	dn	dalpha	dbeta
0,00175	-0,1325	-1,993	-0,1	NA	-0,035	0,06

dA$_1$/							
dc	dk	dm	dt	dalpha	dbeta	d(Y_1*-Y_1)	d(Y_2*-Y_2)
-0,244	0,0957	-1,144	-0,94	-0,819	1,522	-0,0286	0
dA$_2$/							
dc	dk	dm	dt	dalpha	dbeta	d(Y_1*-Y_1)	d(Y_2*-Y_2)
0,0355	0,03415	0,1436	-1,4575	-0,6828	1,268	0	-0,01436

Our aim to study with set I and set II is to be able to examine how the size of redistribution, fiscal discipline, optimal tax efforts, and comparative static results change in cases of different income targets and equalization. Under equalization, the effects of all the parameters on the size of redistribution are the same with the case of different income targets. Although the effects of most of the parameters on optimal tax efforts are the same with the case of different income targets, the effects of c and m differ. As the portion that goes to the pool of CG increases, while the optimal tax effort of the 1st locality decreases, the optimal tax effort of the other increases. This is contrary to the different income targets case.

But, as in subsection 5.1.1, the negative effect of c is dominant, so that c affects the size of redistribution negatively.

The negative impact of m on A_2 in subsection 5.1.1 turns out to be positive in this subsection due to the lower deviation[17]. Furthermore, positive higher deviation leads m to have negative effect on A_1[18]. In summary, we have mentioned main differences in comparative static results in cases of different and equal income targets. In the next section a comparison of the two cases is studied.

5.1.3 Different Income Targets versus Equalization

In this section, we compare optimal tax efforts, total tax efforts, and the size of redistributions that are determined in sections 5.1.1 and 5.1.2.

If we equalize the income targets of the two local governments, we observe that locality 1 applies lower optimal tax effort whereas locality 2 performs higher than the unequal income target case. The reason for this reverse effect is the changes in the respective income deviations. Even though the deviation of the 1st locality increases, which in turn increases the total size of its transfers, the deviation of the 2nd decreases (in fact turns negative). Hence, to compensate for the negative effect of the deviation on its transfers, the 2nd jurisdiction increases its tax effort.

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[17] $Y_2^* - Y_2$ is lower in 5.1.2 than in section 5.1.1.

[18] $Y_1^* - Y_1$ is higher in 5.1.2 than in section 5.1.1.

As a result, greater size of redistribution is obtained in the case of equal income targets, because the sum of the deviations of the two jurisdictions is higher in that case, which leads to higher compensation. But, on the other hand, this higher compensation causes lower performance in total tax efforts.

Therefore, in the procedure of fiscal decentralization, equalization across local governments leads to higher size of redistribution but lower fiscal discipline compared to the case of different income targets[19].

5.2 Evaluation of the CG Problem

5.2.1 Different Income Targets

For the calibration of the results emerging from the fiscal centralization procedure, first of all, we study with set I:

$$\alpha = 0.65,\ \beta = 0.35,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10,$$
$$Y_1^* = 10,\ Y_2 = 20,\ Y_2^* = 25,\ 0 < k \leq 0.1$$

But, to be able to calibrate the procedure, additionally we need tax efforts of the two localities. These tax efforts should be assigned so as to satisfy assumptions of the model as we have mentioned. Moreover, the assignment should be in such a way that the comparison of the fiscal procedures is feasible. Within this framework, we think about two methods to assign values to tax efforts. In the first method (Method

[19] This is not a general finding; most probably it depends on the calibration values we have used. In a further study we examine whether the result is sensitive to parameter selection or not.

1), initially the localities decide on their optimal tax efforts based on their optimization subject to the redistribution rule and announce them to the central government with the LG's optimal size of redistribution. The central government takes into account the announced optimal size of redistribution and one of the tax efforts (in our case we take the optimal tax effort of the 1st locality). In the light of this information, then it decides the optimal tax effort of the other locality in its own set up. In other words, under the distribution of optimal transfers, CG considers the decisions of the localities regarding tax effort and the size of implied redistribution. In this context, we take $A_1^o = 0.707$ and $TR = 0.966$ of the LG problem, and using equation (3.13) we obtain $A_2 = 0.61$ (as compared to $A_2^o = 0.632$). Hence, our first tax effort pair is $(0.707, 0.61)$. Calibration of the fiscal centralization procedure by means of this pair enables us to compare fiscal discipline provided in two fiscal procedures.

The second method (Method 2) is the evaluation of both of the optimal tax efforts announced by the localities by the central authority. That is, CG takes into consideration the announced optimal tax efforts, and under its own set up it decides the optimal transfers and the size of redistribution. Therefore, the second method enables us to compare the size of redistributions of the two fiscal procedures. In the second method, we take $A_1^o = 0.707$ and $A_2^o = 0.632$ of the LG problem, that is our second tax effort pair is $(0.707, 0.632)$, and then in the procedure of fiscal centralization we get $TR = 0.985$ according to equation (3.13).

Now, we have two cases i.e. two pairs, $(0.707, 0.61)$ and $(0.707, 0.632)$, to study for each set of calibration values, set I and set II. Initially, we calibrate optimal level of transfers allocated to the localities using equation (3.16) and the size of redistribution according to equation (3.13) using

$$\begin{aligned} &A_1 = 0.707,\ A_2 = 0.61,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10, \\ &Y_1^* = 10,\ Y_2 = 20,\ Y_2^* = 25,\ 0 < k \leq 0.1 \end{aligned}.$$

The calibration yields $TR_1 = 1.61$ and $TR_2 = -0.65$. The first locality receives higher transfers than the other; indeed the second jurisdiction is punished. The reason is the dominating effect of the actual output of the 2nd locality, which is higher than that of the other, on the optimal transfer solutions of the CG problem for both jurisdictions. The size of redistribution is therefore $TR = 0.966$.

Now, we evaluate the procedure at

$$\begin{aligned} &A_1 = 0.707,\ A_2 = 0.632,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10, \\ &Y_1^* = 10,\ Y_2 = 20,\ Y_2^* = 25,\ 0 < k \leq 0.1 \end{aligned}$$

where the tax efforts are the optimal solutions to the LG problem.

Utilizing equation (3.16), we find that $TR_1 = 1.74$ and $TR_2 = -0.75$, which yields $TR = 0.985$ due to equation (3.13). The reason for locality 1 to receive higher transfers than the other is the same with the previous case. The size of redistribution obtained via the second method is larger than the one obtained via the first method, due to higher A_2 in the method 2.

Table 3 reports all calibrated values we get from our analysis for the CG problem for two methods (1st row reports for method 1 and 2nd row for method 2).

Table 3 Calibration of the CG problem with different income targets

CG PROBLEM

Y_1=10, Y_1*=10, Y_2=20, Y_2*=25, k=0.1

A_1	A_2	TR_1	TR_2	total TR	Total A_i			
0,707	0,61	1,610	-0,65	0,966	1,317			
0.707	0.632	1,74	-0,75	0,985	1,342			
dTR/ dc	**dk**	**dm**	**dt**	**dn**	**dA_1**	**dA_2**	**$d(Y_1^*-Y1)$**	**$d(Y_2^*-Y2)$**
9,8	0	0	1,87	NA	0,5	1	0	0
9,9	0	0	1,97	NA	0,5	1	0	0
$d(TR_1)$/ dc	**dk**	**dm**	**dt**	**dn**	**dA_1**	**dA_2**		
3,4	0	0	3,25	-2,4	-2	5		
3,4	0	0	3,45	-2,5	-2	5		
$d(TR_2)$/ dc	**dk**	**dm**	**dt**	**dn**	**dA_1**	**dA_2**		
6,1	0	0	-1,35	-2,4	2,5	-4		
6,3	0	0	-1,5	-2,5	2,5	-4		

As can be observed from the table, the first method enables us to observe that the procedure of fiscal centralization with different income targets leads to lower fiscal discipline than fiscal decentralization. In addition, under the second method, that is when the localities decide on the optimal tax efforts and then the central government incorporates both of these efforts into its own procedure, higher size of redistribution is obtained compared to fiscal decentralization.

The size of redistribution increases as the portion that goes to the pool of CG increases as expected, since an increase in collection causes TR to increase as well. Moreover, tax efforts of the local governments and common income tax rate affect the collection of the central government positively, which in turn have positive effects on the size of redistribution.

Transfers received by the 1st locality decreases with its own tax effort and increases with the tax effort of the other locality. Similar argument is also valid for the second locality. The negative effect of own tax effort on the transfers received by the locality depends on $\left(c - \frac{1}{n}\right)$, where we assume $n = 2$ and $c = 0.1$. Hence, $\left(c - \frac{1}{n}\right) < 0$.

5.2.2 Equal Income Targets

To be able to analyze "*equalization*" in the CG problem, now we consider set II for calibration analysis:

$$\alpha = 0.65,\ \beta = 0.35,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10,$$
$$Y_1^* = 18,\ Y_2 = 20,\ Y_2^* = 18,\ 0 < k \leq 0.1$$

However, set II is indeed same with set I in the context of CG's optimization problem because we do not consider income targets in the constraint. But, we use two methods utilizing the LG's optimization which involves target incomes. Hence, set II enables us to compare the CG problem in the frame of income targets.

To analyze the fiscal centralization procedure in every respect, similarly we need tax efforts of the two localities. The first method yields the following tax efforts pair: $(0.4782, 0.92)$, respectively for the two localities; and the second method yields $(0.4782, 0.7322)$, which are the optimal tax efforts of the LG problem. Hence, our initial calibration analysis utilizes the following set of values:

$$A_1 = 0{,}4782,\ A_2 = 0{,}92,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10,$$
$$Y_1^* = 18,\ Y_2 = 20,\ Y_2^* = 18,\ 0 < k \le 0.1$$

Using equation (3.16) and above values, we get $TR_1 = 3.6$ and $TR_2 = -2.5$, and hence $TR = 1.16$.

Due to its higher actual output than the 1st jurisdiction, 2nd jurisdiction receives higher transfer from the central government as can be observed from the numbers. The effect of the actual incomes on the optimal transfers is dominant compared to the effect of the tax efforts resulting in positive TR_1 and negative TR_2.

The second method which utilizes the optimal tax efforts of the LG problem is used where the calibration values are as follows:

$$A_1 = 0,4782,\ A_2 = 0,7322,\ c = 0.1,\ t = 0.5,\ m = 0.2,\ Y_1 = 10,$$
$$Y_1^* = 18,\ Y_2 = 20,\ Y_2^* = 18,\ 0 < k \le 0.1$$

Optimal transfers given to locality 1 and 2 are then $TR_1 = 2.7$ and $TR_2 = -1.74$. The size of redistribution is therefore, $TR = 0.98$.

The size of redistribution obtained via the first method is higher than that is obtained via the second method due to higher A_2 than in the second method.

Table 4 indicates calibration results of the analysis including comparative static results, where the 1st row is obtained by the first method and the 2nd is via method 2.

Table 4 Calibration of the CG problem under Equalization

CG PROBLEM

Y_1=10, Y_1*=18, Y_2=20, Y_2*=18, k=0.1

A_1	A_2	TR_1	TR_2	total TR	Total A_i
0,4782	0,92	3,600	-2,5	1,16	1,398
0,4782	0,7322	2,7	-1,74	0,98	1,2104

dTR/ dc	dk	dm	dt	dn	dA_1	dA_2	$d(Y_1^*-Y_1)$	$d(Y_2^*-Y_2)$
11,5	0	0	2,3	NA	0,5	1	0	0
9,8	0	0	1,86	NA	0,5	1	0	0

$d(TR_1)$/ dc	dk	dm	dt	dn	dA_1	dA_2
2,4	0	0	7,2	-3,2	-2	5
2,4	0	0	5,4	-2,76	-2	5

$d(TR_2)$/

dc	dk	dm	dt	dn	dA_1	dA_2
9	0	0	-5	-3,2	2,5	-4
7,2	0	0	-3,5	-2,76	2,5	-4

Now, higher size of redistribution is obtained via the first method because higher A_2 is provided under equal income targets than in the unequal income targets case.

The effects of the portion that goes to the pool of CG, common income tax rate, and tax efforts on the size of redistribution are all positive.

In the following subsection we compare the results we get in sections 5.2.1 and 5.2.2.

5.2.3 Different Income Targets versus Equalization

As we have mentioned previously, a definite result about the size of redistributions can be obtained by means of comparisons in the context of two methods used in subsections 5.2.1 and 5.2.2. Within this context, the following proposition arises:

Result 1: Although, in the procedure of fiscal centralization, equalization across local governments leads to higher fiscal discipline compared to different income targets case, it causes lower size of redistribution[20].

[20] We think that this result may be due to different total deviations under different income targets and equalization. For different values of total deviations the cases should be analyzed.

5.3 Comparison of the Fiscal Procedures

In this section, we compare the two procedures, fiscal decentralization and fiscal centralization, in the framework of fiscal discipline and the size of redistribution. Moreover, we have two cases in each procedure, different income targets and equalization, which make us to do the analysis for each case separately. Therefore, subsection 5.3.1 presents the comparison of the LG and CG problems under different income targets, and subsection 5.3.2 presents the analysis for equalization.

5.3.1 Comparison of the Fiscal Procedures under Different Y_i^* [21]

Result 2: Under the provision of the same size of redistribution, fiscal decentralization leads to higher fiscal discipline compared to the procedure of fiscal centralization. Moreover, under equal fiscal discipline, fiscal centralization yields higher size of redistribution than that of fiscal decentralization.

5.3.2 Comparison of the Fiscal Procedures under Equalization [22]

Result 3: Fiscal centralization provides higher fiscal discipline than the procedure of fiscal decentralization under the same size of redistribution. In addition, under the provision of equal fiscal discipline, higher size of redistribution is obtained in the procedure of fiscal decentralization.

[21] The result is concluded via the comparison of the tables 1 and 3.
[22] The result is concluded via the comparison of the tables 2 and 4.

Results 2 and 3 may be due to the numbers assigned to the parameters. Hence, they will be analyzed under different calibration values in further studies. Furthermore, the following propositions arise:

Proposition 3: In the procedure of fiscal decentralization, the portion that goes to the pool of CG has a negative effect on the size of redistribution, however in fiscal centralization a positive effect is observed.

Proposition 4: Even though the common income tax rate has a positive effect on the size of redistribution in fiscal centralization, in fiscal decentralization it affects the size of redistribution negatively.

Therefore, opposite effects of t and c on the size of redistribution are observed in two fiscal procedures.

CHAPTER 6

CONCLUSION

In this study, two fiscal procedures, fiscal decentralization and centralization, including a mechanism of income compensation (as well as equalization) and effort related compensation are analyzed theoretically. The two procedures are represented by the optimization problems of central government and local governments, deciding on the optimal transfers and optimal tax effort respectively. The main assumptions of the model are; the central government allocates all of its collection, the tax effort of any locality should be a positive number less than or equal to one, private consumption and government expenditures of any local government are greater than one, besides other reasonable limitations on the model parameters. Based on the solutions obtained via optimization, comparative static analysis is formed.

Most of the partial derivatives in our analysis give ambiguous results, which in turn force us to utilize the calibration method by assigning reasonable parameter values. Due to tying up to the calibration values, most probably some results we obtain are sensitive to the selected parameter values. Hence, we cannot deduct definite results concerning the effect of fiscal procedures on fiscal discipline. This is an ongoing study, and further analysis will tell us the possible definite results of our model.

We have some preliminary results, however. In the procedure of fiscal decentralization, an increase in the deviation of actual output from its target creates a disincentive for a locality to increase its tax effort due to increase in transfers via the deviation. Furthermore, the positive effect of an increase in the number of localities on fiscal discipline in the procedure of fiscal decentralization is observed. In the procedure of fiscal decentralization, the portion that goes to the pool of CG has a negative effect on the size of redistribution, however in fiscal centralization a positive effect is observed. Moreover, the common income tax rate has a positive effect on the size of redistribution in fiscal centralization, but in fiscal decentralization it affects the size of redistribution negatively.

APPENDIX

For the LG problem we must show that zero is not an optimal solution[23].

Assume that "0" is optimal and $t\alpha \neq -\frac{t(k+(1-c)Y_i)\beta}{(kt+m(Y_i-Y_i^*))}$. Since zero is optimal, it should satisfy the first order and second order optimality conditions. The first order optimality condition for LG problem is (from (3.5)):

$$-\frac{t\alpha}{(1-tA_i)}+\frac{(kt+(1-c)tY_i)\beta}{kt(A_i-1)+(1-c)tY_iA_i+m(Y_i^*-Y_i)}=0$$

Put $A_i=0$ in the above equality, because zero tax effort is assumed to be optimal. Then, we have

$$t\alpha=-\frac{(kt+(1-c)tY_i)\beta}{kt+m(Y_i-Y_i^*)}$$

But, it contradicts our assumption on parameters and exogenously determined variables. Hence, "0" is not optimal for the LG problem.

Our optimal solution A_i^o should satisfy the assumption on A_i, $0<A_i\leq 1$. So, for the LG problem we restrict parameters of our model (defined in subsection 3.1) to satisfy:

$$0< \ (\alpha kt-\alpha m(Y_i^*-Y_i)+\beta(k+(1-c)Y_i)) \ \leq 1$$

which is obtained from equation (3.6). Hence, $0<A_i^o\leq 1$.

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[23] Actually, the utility function of the problem is strictly concave on a positive domain, which enables the problem to have nonzero optimal tax effort obviously.

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