

WELFARE EFFECTS OF INTERGOVERNMENTAL TRANSFERS:
EQUITY VS. EFFICIENCY

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ABSTRACT

WELFARE EFFECTS OF INTERGOVERNMENTAL TRANSFERS: EQUITY VERSUS EFFICIENCY

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Intergovernmental transfers, that are significant source of income for state and local governments, are needed to annihilate the fiscal imbalances. This dissertation aims to investigate the welfare effects of an intergovernmental transfer rules in fiscally decentralized economies. The particular linear redistribution rule used in this study takes into account two criteria: equity and efficiency. The model consists of citizens, symmetric local governments and a central government, which are in a strategic interaction. Our study is the first to include interactions between these agents under a redistribution rule. So, this study focuses on Markov-perfect Nash equilibrium of this economy by a continuum of households and governments that act sequentially. There exist public good spillovers across regions and tax competition between local governments through mobile capital. Welfare is compared among no-rule case and full-

rule (equity and efficiency) case and also among no-equity case and no-efficiency case. The results indicate that the welfare in full rule case is always higher than the one in no rule case. Furthermore, for high levels of capital mobility, no efficiency case has higher welfare level than no equity case. This implies that in case of high mobility government should give more weight to equity case.

Keywords: Fiscal Decentralization, Intergovernmental Transfers, Welfare, Equity, Efficiency

ÖZ

YÖNETİMLER ARASI TRANSFERLERİN REFAH ETKİLERİ: EŞİTLİK VE ETKİNLİK

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Yerel hükümetlerin önemli gelir kaynağı olan yönetimler arası transferler, mali dengesizlikleri azaltmak için gerekli olmaktadır. Bu çalışma, mali yerleşmiş ekonomilerde, yönetimler arası transferlerin refah etkilerini araştırmayı amaçlamaktadır. Bu çalışmada kullanılan belirli lineer transfer kuralı, eşitlik ve etkinlik özelliklerine sahiptir. Modelde, stratejik bir şekilde sırasıyla etkileşim içerisinde olan vatandaşlar, simetrik yerel hükümetler ve merkezi hükümet bulunmaktadır. Bu çalışma, yeniden dağıtım kuralı çerçevesinde bu etkileşimi ele alan ilk çalışmadır. Bu ekonomide bireylerin ve hükümetlerin sırayla etkileşim içerisinde olduğu mükemmel Markov Nash dengesi bulunmaktadır. Kamu malı yayılımları ve hareketli sermaye yoluyla vergi rekabeti gözlenmektedir. Refah, transfer kuralının olmadığı durum ile iki özelliği de olan transfer kuralı durumu ile karşılaştırılmaktadır. Ayrıca etkinlik özelliğinin olmadığı durum ile eşitlik özelliğinin olmadığı durum arasındaki refah seviyeleri karşılaştırması

da yapılmaktadır. Sonuçlar, transfer kuralının olduđu durumun, kuralsız durumuna göre daha yüksek bir refaha işaret etmektedir. Ayrıca, yüksek sermaye hareketliliğın olduđu durumda, merkezi hükümetin eşitlik özelliğine daha fazla ağırlık vermesi gerektiğı sonucu çıkmıştır.

Anahtar Kelimeler: Mali Yerelleşme, Yönetimler Arası Transferler, Refah, Eşitlik, Etkinlik

To My Daughter, ELİF

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CHAPTER 1

INTRODUCTION

Intergovernmental transfers are significant source of income for state and local governments. The necessity of these transfers arises with vertical and horizontal fiscal imbalances. Fiscal imbalances simply occur due to the mismatch of government expenditure and revenue. If this mismatch is observed between two levels of governments such as central and local governments, it is called ‘vertical imbalance’. If it occurs across the same levels of governments such as two state governments, it is called ‘horizontal imbalances’. In order to annihilate these imbalances, intergovernmental transfers are widely preferred by most of the countries (Australia, United States, United Kingdom, Germany, etc.). Gamkhar and Shah (2007) defines intergovernmental transfers as follows:

“Intergovernmental fiscal transfers are frequently used to achieve diverse objectives, including dealing with vertical fiscal gaps, addressing horizontal fiscal inequities, providing compensation for benefit spill outs and influencing subnational policies in taxing, spending and regional and local economic stabilization.”

Despite the necessity of such a rebalancing, intergovernmental transfers may have negative effect on fiscal discipline due to the potential moral hazard problems they create. Central government transfers are laid out as an insurance against negative shocks to local governments due to the equalization concern of the central government between its localities. However, with this support as an insurance without an appropriate control mechanism, local governments might believe to be protected from the consequences of their poor decisions and may fail to make policy actions to protect themselves from potential risks, creating moral hazard

problem. Hence, an effective transfer mechanism should have properties such as: revenue adequacy, local tax effort, equity, transparency and stability (Ma, 1997; Shah, 1995). Revenue adequacy criteria should be included in transfer mechanisms, because the government's responsibility of satisfying the citizens' demands needs sufficient resources. Local tax effort and expenditure control criterion is aimed to make fiscal discipline by providing maximum level of tax effort and not allowing unsustainable fiscal deficits. Other criterion, transparency and stability, should exist for local governments to forecast their own total revenue correctly for preparing their budget. Ma (1997) states that redistribution formulas should be stable for few years to make long-term local plans. The last criterion that Ma (1997) states is equity. The amount of transfers should change according to the fiscal needs of local governments.

Fiscal indiscipline is another concern while distributing the transfers. Local government's dependence on transfers may disrupt fiscal discipline, such as common pool effect, soft financing, grant design, etc. (Eyraud & Lusinyan, 2011)¹ In addition, if central government does not determine any objectives or does not set any target, local government may not use these funds properly, not according to the necessities of citizens². Conditional grants are allocated for specific purposes whereas unconditional grants have no restrictions and aims to equalize the fiscal capacities of different local governments. Unconditional grants are highly preferred among developed countries, due to monitoring problems of conditional grants for

¹ Eyraud & Lusinyan (2011) state harmful effects of transfers to fiscal discipline as common pool effect, soft budget constraint, soft financing, governance and accountability, grant design and vertical spillovers. They explain these reasons one by one. For instance, common pool effect is observed when sub-national governments may overspend with a lower tax effort due to failing internalization of costs.

² For example, a locality needs road construction or improvement in local transportation system (these can be specified as necessities of a citizen living in that locality), but that local government prefers to establish new fountains or parks for beauty concerns. In order to prevent this kind of redundant use, some central governments prefer to use conditional grants, some central governments set targets for local localities to reach and as a reward increase transfer payments. beauty concerns. In order to prevent this kind of redundant use, some central governments prefer to use conditional grants, some central governments set targets for localities to reach and as a reward increase transfer payments.

the central governments. These types of transfers are distributed by central governments to subnational governments in countries like Canada, Australia, United Kingdom, Japan, Korea, whereas in Germany, this type of equalization grant is allocated from an above average fiscal capacity states to below average fiscal capacity states.

Due to moral hazard and fiscal indiscipline concerns in allocating intergovernmental transfers, this study argues the necessity of a redistribution rule. Specifically, this study focuses on the welfare effects of discretionary transfers compared with the welfare effects of linear rule based transfers. This rule based redistribution mechanism has equity and efficiency properties. Another aim of this study is to investigate the relative effect of equity and efficiency concerns in rule-based linear redistribution mechanism in terms of welfare in a fiscally decentralized system, where fiscal decentralization is defined as the devolution of fiscal responsibilities from central governments to sub national governments to improve efficiency in local areas by collecting more reliable data and to increase competition among sub national governments. Local governments are better in monitoring the citizens and can spend revenue more appropriately, however central governments are organizing the regulations and budget for all local governments, in other words they are the main supervisor and regulator to sustain discipline and equality among localities. So, there should be an interaction between central government and local governments. However, in the literature, this interaction is mostly missing. This study tries to fill this gap by introducing 3 levels of interaction between agents: central government, local governments and citizens.

The model in this study is related to Chu and Yang's (2012) endogenous growth model as well as the redistribution rule that Akin et. al. (2016) have presented firstly in the literature. Akin et. al. (2016) investigates the effect of fiscal decentralization with a pre-determined redistribution rule on fiscal discipline compared to a centralized system, in a static model. They find that fiscal decentralization with their rule has a positive effect on fiscal discipline, but income distribution worsens

compared to a centralized system. The public good provision part of our model can be considered as an extension of Besley and Coate's (2003) public provision model. In Besley and Coate's model, the public good provision model is in the static form without tax competition. Also, Chu and Yang's model is a dynamic endogenous growth model with the allowance of tax competition and public good spillovers. The main difference from Chu and Yang's model from our model is the existence of redistribution mechanism that Wilson (1999) claims as a necessary procedure³ if tax competition exists in the model. In our model with redistribution mechanism, central government has no direct effect on fiscal policy but through transfer rule it has an indirect effect.

Another contribution is that intergovernmental transfers, different from lump-sum transfers, combining with fiscal decentralization are not mentioned in the literature in theoretical papers.⁴ This study also attempts to fill this void. When a central government pledges a certain level of transfers (lump-sum transfers), only vertical imbalances can be reduced without controlling any local government fiscal responsibility (such as higher income levels, maximum tax collection efforts, etc.). However, distributing transfers from a higher level of authority (national government) to a lower level of authority (subnational government) is a crucial fiscal tool in annihilating fiscal imbalances. As emphasized before, Ma (1997) and Shah (1995) mention properties of a well-designed intergovernmental transfer, and lump-sum transfers are not able to satisfy these properties. Hence, a redistribution rule that is aimed to satisfy these properties with interactions between citizens and governments is an important contribution for the literature. In addition, which

³ Tax competition may cause some inefficiencies in the economy. As will be discussed in the coming paragraph and in the literature review part, mainly two inefficiencies may be observed because of tax competition. First one is the inefficiently low level of public good provision and second one is the misallocation of capital across localities. Wilson (1999) argues that these inefficiencies may be corrected with the redistribution of revenues by a central authority.

⁴ Studies about intergovernmental studies mainly focus on country case studies or the effects of transfers on economy in an econometric study. (Bahl and Linn, 1992; Schroeder, 1988; Bahl and Linn, 1994; Ma, 1997; Shah, 1994; Bahl, 2000a; Bird, 2001; Bird and Smart, 2002; Schroeder and Smoke, 2002; Dahlby and Fered, 2012) Since it is hard to construct a rule for distributing transfers, theoretical papers prefer to use lump-sum transfers in their models. (Wildasin, 1984; Boadway and Flatters, 1982; Wildasin, 1983; Sheshinski, 1977; Sanguinetti and Tomassi, 2004)

country should give more emphasis to which property is another important question in this framework. This study also looks for answers for this question.

According to Wilson (1999), an efficient level of public good provision or capital distribution cannot be seen in the existence of tax competition, but if a central authority distributes transfers across jurisdictions, the governments may reach that goal. Wilson proves his idea by showing that efficient allocation can be achieved by providing lump-sum transfers to the localities through a cost-benefit analysis. Wildasin (1986) entitles this kind of intergovernmental transfers as ‘corrective subsidy’. He argues that the necessity of such intergovernmental transfers arises from inefficiency associated with tax competition. After showing this kind of inefficiency is indeed a fiscal externality, internalization of this externality is observed when intergovernmental transfers are imposed to the model. He also uses cost-benefit analysis with lump-sum transfers. In addition, Inman and Rubinfeld (1996) suggest a design of tax policy in federalist economies. In order to correct the inefficiencies and inequities arising from taxation by lower levels of governments, one of their suggestions is distribution of transfers by central government. The potential problem of inefficiencies in public good provision due to tax competition, which is an inherent property of our model, is eliminated due to the existence of transfers that the central government distributes according to a redistribution rule.

The linear redistribution rule used in this study takes into account two criteria: equity and efficiency. This mechanism is a slightly modified version of the rule used in Akin, Bulut-Cevik & Neyapti (2016)⁵. As the purpose of equity property is to equalize the capacity of local governments in provision of a certain level of public services, the redistribution rule generates positive transfers if the localities income falls below an exogenously set target level. Efficiency part aims to promote fiscal discipline by targeting a level of tax revenue. If a locality cannot reach tax revenue target level then central government punishes the locality and decreases the

⁵ For detailed discussion, see Section 3.3

transfer amount. The purpose of putting a target for tax revenue is to increase local tax collection effort⁶.

As mentioned in the literature, intergovernmental transfer mechanisms are established in order to annihilate the fiscal imbalances. With this aim, some properties should be included such as revenue adequacy, transparency, local tax effort, predictability, stability and equity. (Ma, 1997; Shah, 1995) Redistribution rule in this study is linear and has equity and efficiency properties. Linearity assumption is imposed to assure that all agents in the economy can easily predict the transfers. This will help local governments to make long-term budget plans and so ensure stability and transparency. Efficiency property is included due to satisfy the revenue adequacy and local tax effort. In addition, equity property is added in order to annihilate horizontal imbalances, equity.

Hence, in this study, the welfare properties of a linear intergovernmental redistributive transfer rule in a decentralized fiscal policy setting are investigated. We do so by comparing the welfare levels of discretionary (no-rule) case with full-rule (efficiency and equity) case and comparing the welfare levels of full-efficiency (no-equity) with full-equity (no-efficiency) case. In full-rule, which includes equity and efficiency properties, central government decides the redistributive rule parameters, and so decides the transfer amounts implicitly. However, in no-rule, local governments can use their own locality's tax revenue, in other words, local governments spend what they collect from citizens. This comparison provides us to see the necessity of a redistribution rule in fiscal decentralization settings from a welfare point of view. Furthermore, in no-equity, central government decides transfer amounts implicitly by only taking into account tax collection efforts, whereas, in no-efficiency, central government only cares about equalizing income levels across localities. With this welfare comparison, our aim is to answer under

⁶ The purpose of putting a target for tax revenue is to increase local tax collection effort. Stowhase and Traxler (2005), Ma (1997), Akin et.al (2016) point out the importance of tax collection effort in a transfer mechanism. In addition, Bird and Smart (2001) also mention the importance of efficiency and equity features in a well behaved transfer mechanism

which conditions (such as high levels of capital mobility, low levels of public good spillovers, etc.), central government should give more weight to which property.

We find that for low levels of capital mobility, no equity case, in which redistribution rule only has efficiency property, has higher welfare levels compared to no efficiency case. Thus a benevolent central government operating under low levels of capital mobility should put more weight to efficiency compared to equity. We also find that the welfare in full redistribution case is always higher than the one in no redistribution rule case. It shows usefulness of the redistribution mechanism from the welfare point of view. This finding is consistent with Sanguinetti and Tomassi (2004) and Wildasin (1984).

The organization of this paper is as follows: in Chapter 2, related literature with this study is reviewed with particular emphasis on fiscal decentralization, intergovernmental transfers, tax competition and public good provision. Chapter 3 introduces the model, and Chapter 4 solves the model for different parameterizations of the model, which involves: i. no equity property in redistribution rule, ii. no efficiency property in redistribution rule, iii. both equity and efficiency properties in redistribution rule (full redistribution), iv. no redistribution rule. Using simulation, comparative statics with welfare comparisons between these alternative cases are investigated in detail in Chapter 5. Chapter 6 provides the overall summary, conclusions and suggestions for further research.

CHAPTER 2

LITERATURE REVIEW

The logic of the fiscal decentralization concept is firstly constructed by Tiebout (1956). He criticizes Musgrave (1939) and Samuelson (1954, 1955) studies that prove optimal levels of public good provision exist if agents declare their true preferences while voting. He argues that the provision of local public goods such as fire protection, police, education and hospitals is not necessarily provided by central government, but by local governments. He also states that since the preferences of individuals may be too different, centralized governments might be unsuccessful in fulfilling their needs. Local governments can observe the citizens and determine their needs better and less costly due to the geographical proximity, so they can use public spending more suitable to the individual's needs. In addition, he introduced 'foot voting' or 'vote with their feet' terms into the literature by imposing mobile household assumption into his model. Households decide where to live according to their preferences about tax and public goods, which leads to 'market-type solution'⁷

Another influential contribution is done by Oates (1972), who introduces 'fiscal federalism'⁸ term into the literature. As Tiebout (1956), Oates mentions the spatial characteristics of public goods. Some public goods, such as defense, have no locational property, but some public goods, such as street lighting, transportation system, have region-specific properties. Since central governments embrace 'one-size-fits-all' approach, they cannot provide optimal levels of public good. Oates

⁷ Tiebout mentioned 'market type solution for public goods' which stands for decentralized and efficient allocations of public goods.

⁸ Fiscal federalism and fiscal decentralization represent the same concepts in this study

(1972) focuses on arising differences between centralized and decentralized public good provisions and concludes a ‘Decentralization Theorem’ as follows:

“For a public good—the consumption of which is defined over geographical subsets of the total population, and for which the costs of providing each level of output of the good in each jurisdiction are the same for the central or for the respective local government—it will always be more efficient (or at least as efficient) for local governments to provide the Pareto-efficient levels of output for their respective jurisdictions than for the central government to provide any specified and uniform level of output across all jurisdictions”

The basic implication from this theorem is that if preferences of citizens diversify according to their locational features, uniform bundle of public goods may force some localities to spend more or less they prefer to spend. In other words, if provision decision is made by a local government, because of the higher possibility of ‘perfect correspondence’⁹ with the necessity of a citizen, optimal level of public good can be succeeded. One important assumption that he did is that the governments are fully benevolent, i.e. they maximize social welfare.

In order to comment on fiscal decentralization, we firstly have to examine the inefficiencies in the centralized system. In a perfect information world, a benevolent central government can observe the necessities of the households and provide them properly. However, in the real world, there exist asymmetric information and imperfections. Moreover, local governments have much more information about the preferences and costs of individuals compared to the central government because of the geographical proximity. Also, due to the political pressure (such as spending for political concerns) on central governments, central governments may not provide desired levels of public services. For example, the case of federal highway spending in United States¹⁰ or spending on river and harbor projects by the Army Corps of Engineers¹¹ or spending on parks by the Department of the Interior in United States.

⁹ Oates, 1972, p.34

¹⁰ Besley and Coate, 2003

¹¹ Ferejohn, 1974

In addition, political economy plays a significant role in spending public revenue. Although central governments claim that they are fair in allocating the resources, political interest gives direction to these spending.¹²

An important part of fiscal policy, in addition to providing macroeconomic stability, fiscal authorities also have social policy responsibilities such as fighting against poverty. Despite implementing social policy and poverty alleviation are usually assumed to be the responsibility of the central government, studies¹³ show that decentralized fiscal structures carry out these policies more successfully. As the role of local governments in identifying social issues and taking social policy decisions increases, social policy becomes more effective. (Bradford, 2004, Bradford, 2005; Broadbent, 2008; Fowler & Siegel, 2002). The main reason behind this argument is that the needs and preferences of citizens can be monitored better by local governments because of the proximity. By tailoring the specific goods and services, the level of public good is likely to change efficiently across localities. Hence, central governments have tendency to give more power or responsibilities to the local governments especially for which have very heterogeneous structure inside the country.

Another contribution to fiscal decentralization literature from the public choice view is Brennan and Buchanan (1980). They first developed Leviathan model of government, which maximizes revenue and acts like a monopolist. They find that fiscal competition among local governments through a decentralized fiscal system gives similar outcomes with case when there are fiscal constraints on central government's taxing power under the assumption of mobility of households and firms. As the public sector becomes larger, the resources are used more inefficiently

¹² Knight (2002) analyses the allocation of funds in Federal Highway Aid Program and argues the manipulations in this program. Even, Senator Patrick Moynihan says 'You don't have a formula, you have only 50 negotiated numbers' (Washington Post, May 23, 1998- cited in Knight, 2002)

¹³ Case studies: Chappell, 2001; Winston & Castañeda, 2007; Tausz, 2002; Wilson, 2006; Hasso, 2010

and extravagantly. So decentralization gives more efficient allocations due to the smaller public sector structure.

After the concept 'fiscal decentralization' is introduced to the literature, empirical studies about the relation between fiscal decentralization and size of government, economic growth and welfare levels are widely investigated. The main finding about the effects of decentralization on size of government, measured as government expenditure or revenue, is that decentralization significantly lowers aggregate government expenditure (Grossman, 1989; Grossman and West, 1994; Marlow, 1988; Ehdaie, 1994; Fiva, 2005)

Besides the 'good side' of fiscal decentralization (Brueckner, 2004), the 'bad side' of fiscal decentralization arises with 'tax competition'. Arguments about the effects of tax competition to the economy has been widely discussed and not reached an agreed decision yet, but most of the studies in this literature argue that inefficient level of public good provision is observed due to low levels of tax rate. (Bradford and Oates, 1971; Oates, 1972; Rohac, 2006; Brueckner, 2003). Oates (1972,p.143) describes this problem as follows:

“The result of tax competition may well be a tendency toward less than efficient levels of output of local services. In an attempt to keep taxes low to attract business investment, local officials may hold spending below those levels for which marginal benefits equal marginal costs, particularly for those programs that do not offer direct benefits to local business”

Local governments have an incentive to decrease the tax rates due to not only the political concerns but also attracting more capital to his locality as Oates (1972) states. This tax rate reduction causes the under-provision of public goods, so that normative public economists (Musgrave, 1997; Zodrow and Mieszkowski, 1986) claim the tax competition as being wasteful and self-defeating (Sato, 2003).

Furthermore, one of the inefficiencies¹⁴ of tax competition is misallocation of capital across jurisdictions. In high tax jurisdictions, less amount of capital exist which implies marginal product of capital is relatively high in those high tax jurisdictions. Different tax rates cause different factor endowments, which cause misallocation of capital. (Wilson, 1999) On the other hand, decentralized fiscal system is necessary in disciplining the local governments. (Brennan and Buchanan, 1980; Frey and Eichenger, 1996)

The earlier literature on intergovernmental transfers, so-called first generation theories, focuses on the ‘flypaper effect’, which argues that the impact of lump-sum grants to a locality should be equal to the effects of lump-sum funds given directly to local residents. (‘Veil Hypothesis’¹⁵, Bradford and Oates, 1971) However, empirical work shows that the impact of lump-sum grants to local public expenditure is higher than the effect of equal increases in private income. (Gramlich, 1977; Hines & Thaler, 1995; Bailey & Connolly, 1998) Recently, second generation theories focus on the efficiency and equity implications of these grants in decentralized federal systems. Barette, Huber and Lichtblau (2002) argue the effects of equity property of a transfer policy for German. They show that when income increases in a state, transfers are reduced to compensate reductions in other states’ incomes. Their empirical analysis shows that this negative relation between transfer amounts and income has some distortionary effects such as reducing the tax revenue of states. Some scholars (Shah,2004; Spahn 1997, 2005; Ihuri and Itaya, 2004; Folscher, 2004) emphasize the importance of fiscal discipline in local government budget constraints. The limitations in spending and maximizing the tax collection efforts are the main tools for fiscal discipline through intergovernmental transfers. In addition, according to Cai and Treisman (2004), negative effects of

¹⁴ Efficiency stands for “*an authority cannot feasibly reallocate goods and resources in a way that makes some individuals better off without making anyone worse off*” (Wilson, 1999)

¹⁵ Bradford and Oates (1971) predict that direct transfer to local residents have equal effect on community income with direct transfer to local government. And since these transfers can be considered as a veil to central government’s tax rebates, they call this ‘Veil Hypothesis’.

competition across jurisdictions can be corrected by federal government intervention through a transfer policy.

There are a number of studies about defining a well-designed transfer mechanism. These studies start with examining the countries' redistribution mechanisms. Ma (1997) examines intergovernmental fiscal transfers of nine countries. Ma's findings show that Canada, Australia, Germany and India have been using rule based equalization grant mechanism, whereas countries like United States and United Kingdom prefer to use conditional grants. The determinants of transfers distributing in Korea and Indonesia depend on various factors such as necessities as a provincial development, district development, village development, etc.

Since collecting reliable information and data is difficult to get in the level of provinces or states, studies on redistribution mechanisms are mainly focusing on trade-off between rules and discretion. Sanguinetti and Tomassi (2004) investigate two scenarios under asymmetric information. One is the pre-commitment of central government by giving a certain level of transfers as ex-ante insurance; the other is covering the ex-post fiscal needs in a static model, resembling to rules versus discretion debate. They find a range of parameters for which one or the other case is preferable from the welfare point of view. In the case of large local shocks, ex-post insurance model is preferred, whereas in the case of high degree of fiscal decentralization, ex-ante transfer model is preferred.

Another important debate in the literature is the utility structure of local governments. Local governments, which maximize the local welfare of its population, are called 'Pigouvian' governments. (Zodrow and Mieszkowski, 1986) On the other hand, Brennan and Buchanan (1980) define governments as pure rent-seekers, who provide public goods with expectation to collect rents for themselves, and call them 'Leviathan' governments. Edwards and Keen (1996) examine welfare effects of tax competition and find mixed findings. Basically, they conclude that if governments are not fully self-serving, but partly benevolent then desirable levels of

policy variables are observed. Rauscher (1998) also use this kind of government (neither fully benevolent nor fully self-caring) in his studies to show that inter-jurisdictional competition for mobile factors of production forces the government to raise the efficiency of the public sector. In addition, Epple and Nechyba (2004) compare these two extreme models of local government behavior from local tax rates and public good levels and concluded that both not fully selfish and not fully benevolent government give desired levels of tax rate and public good simultaneously.

CHAPTER 3

THE MODEL

The model is an A-K type endogenous growth model with continuous time. The model consists of citizens, local governments and a central government. There is interaction between these three agents in the economy with a sequence of events. There exist tax competition between local governments and public good spillovers across regions. Capital is mobile but costly. Also, capital income is the only revenue source for the governments.

In this study, the welfare properties of a linear redistribution rule in a decentralized fiscal setup will be examined. In the model, three sets of agents exist; citizens, local governments and a central government, strategically interacting along the dimensions explained below. In this model, central government plays a role by organizing transfer amounts following a pre-determined rule, but local governments decide the fiscal policy, which makes local governments be policy-making governments and central government be passive government.

Local governments choose their policy independently, simultaneously but non-cooperatively for each point in time t to maximize the welfare of its local citizens, taking the central government's redistribution rule given. There exist public good spillover between localities, which are not internalized by the local governments and there exists tax competition since each locality chooses its own tax rate at each time t and capital, which is the tax-base, is mobile. In addition, local governments

may not be fully benevolent¹⁶. Central government has no direct role in fiscal policy only determines the redistribution parameters to satisfy its instantaneous balanced-budget constraint. Citizens maximize their lifetime utility subject to their flow budget constraint.

The timing of the events is as follows:

- Central government announces that it will implement a redistribution rule and decides relevant parameters
- Local Government determines the fiscal policy variables
- Given policy, citizens maximize their own lifetime utility

As stated in the introduction part, this model has some similarities with Chu and Yang's endogenous growth model (2012). As in their decentralized model, A-K type endogenous growth model is preferred. Also, capital mobility with tax competition are included in their study. However, there is no central government or redistribution mechanism that Wilson (1999) states as a necessary tool if you include tax competition in your model. Besley and Coate's static public good provision model (2003) is utilized in introducing the terms 'home locality' and 'neighbor locality' and related constructions. Central government distributes transfer payments according to a linear redistribution rule. This rule-based redistribution mechanism, which is introduced by Akin, Bulut-Cevik and Neyapti (2016), takes into account equity and efficiency. There is a slight difference, which is not existence of tax collection effort in this model. In addition, Bulut-Cevik and Neyapti (2014) also analyze welfare effects of fiscal decentralization in case of similar fiscal transfer mechanism. They find that as redistribution rule becomes stricter, fiscal efficiency and welfare gets higher, however in their model there is neither citizen as an agent nor tax competition, public good spillovers and capital mobility with capital income taxation.

¹⁶ A parameter, L , is set exogenously to determine the degree of selfishness of the politician. See 3.2 for detailed discussion

3.1 Citizen's Problem

There is a continuum of individuals who live in geographically different but symmetric regions. For simplicity, there are two jurisdictions, '1' and '2', which may be understood as neighbor states with the same populations. Also, 'home jurisdiction' phrase can be used instead of locality '1' and 'neighbor jurisdiction' can be used for locality '2'

The subscript 't' is used as time. Superscript '1' represents the citizen living in locality '1' and since citizens are representative agents, it can be said: 'superscript '1' shows the citizen '1'. However subscript '1' is directly used for locality. In order to be clear, the level of capital that belongs to a citizen can be written as follows:

$$K_t^1 = K_{1,t}^1 + K_{2,t}^1$$

where $K_{1,t}^1$ is the level of capital belonging to a citizen who lives in locality '1' (superscript) and rents capital from locality '1' (subscript) at time t . $K_{2,t}^1$ is the level of capital belonging to a citizen who lives in locality '1' and rents capital from locality '2' at time t .

In addition, the level of capital that is taxed in locality '1' can be represented as follows:¹⁷

$$K_{1,t} = K_{1,t}^1 + K_{1,t}^2$$

where $K_{1,t}^1$ is the level of capital belonging to a citizen who lives in locality '1' (superscript) and rents capital from locality '1' (subscript) at time t . $K_{1,t}^2$ is the level

¹⁷ For instance, take two cities in Turkey: Izmir and Ankara. A businessman from Izmir decides to open a factory in Ankara. During opening a factory in Ankara, tax is paid to Ankara municipality, however for other factories in Izmir, that businessman pays taxes to Izmir municipality.

of capital belonging to a citizen who lives in locality '2' and rents capital from locality '1' at time t .¹⁸

The citizens maximize their lifetime utility subject to flow budget constraint. The most general form of lifetime utility is as follows:

$$U = \int_0^{\infty} e^{-\rho t} [\ln C_t + \ln G_{1,t} + s \ln G_{2,t}] dt \quad (1)$$

where $\rho > 0$ is the discount rate, C_t is the consumption level at time t , $G_{1,t}$ is the public good level at home jurisdiction and $G_{2,t}$ is the public good level at foreign jurisdiction. $s \in [0,1]$ represents the degree of the positive spillovers. s cannot be bigger than 1 because the citizen should take at least equal utility from the level of public good at home jurisdiction. When $s = 0$, the citizens only care about his home public good level whereas if $s = 1$ the citizens take equal utility from the levels of public good at both jurisdictions. The idea of this set-up is similar with Besley and Coate's (2003) public good provision model.

The citizens maximize their lifetime utility to decide how much to consume and to save or invest for each point in time, which means the choice variables are today's consumption and next period's capital level. The flow budget constraint is the usual net balance between income, savings and spending. The budget constraint is as follows:

$$\dot{K}_t^1 = (1 - \tau_{1,t})r_1K_{1,t}^1 + (1 - \tau_{2,t})r_2K_{2,t}^1 - C_t - M(\theta_t^1, K_t^1, m) \quad (2)$$

where K_t^1 is the capital level belonging to citizen who lives in locality '1', $\tau_{1,t}$ is the tax rate levied on each unit of capital at home jurisdiction, $\tau_{2,t}$ is the tax rate levied on each unit of capital at neighbor jurisdiction at time t and r_1 is the rental rate of return at home whereas r_2 is the rental rate of return in neighbor jurisdiction.

¹⁸ See Appendix A for detailed information.

As in the standard AK model, capital includes human capital, tangible and intangible capital with embodied technologies. (Rebelo, 1991) In this model, agents are not allowed to move, so tax competition is observed under mobile capital. Due to allowance of mobility of capital, there are different levels of capital per citizen for both jurisdictions. In budget constraint, at time t , the capital level distributed to the home locality is denoted as $K_{1,t}^1$, whereas the capital level distributed to the other locality is denoted as $K_{2,t}^1$. The total amount of tax paid to the government is $\tau_{1,t}r_1K_{1,t}^1 + \tau_{2,t}r_2K_{2,t}^1$ at time t . The ratio of capital allocated to the foreign jurisdiction over total capital per citizen at time t is represented with $\theta_t^1 = K_{2,t}^1 / K_t^1$, so $1 - \theta_t^1 = K_{1,t}^1 / K_t^1$ is the ratio of capital allocated to the home jurisdiction over total capital per citizen at time t . So since $K_t^1 = K_{1,t}^1 + K_{2,t}^1$, another constraint for the citizen problem should be;

$$\theta_t^1 \in [0,1]$$

In this study, as stated above tax competition is introduced (i.e. τ_1 may not be equal to τ_2), also irrespective of residency or ownership of capital, tax is levied on the location of capital. This type of taxation is known as ‘source principle taxation’ or ‘source based taxation’¹⁹

The other term in the budget constraint is the cost function of investing to a neighbor (foreign) market, $M(\theta_t^1, K_t^1, m)$. It can be considered either as facing uncertainties such as foreign legal issues, foreign country-specific risk, etc. or the cost of gathering information about legal issues or about marketing. In other words, it includes all frictions belonging to neighbor capital allocation compared to domestic allocation. The functional form is similar with the ones in the papers of

¹⁹ Keen (1993), Wellisch (2000), Haufler (2008)

Persson and Tabellini (1992), Lejour and Verb (1997) and Chu and Yang (2012). The form of cost function is as follows:

$$M(\theta_t^1, K_t^1, m) = K_t^1 (\theta_t^1)^2 / m$$

where $m \in (0, \infty)$ is the degree of capital mobility. If $m = \infty$, i.e. the capital is perfectly mobile, then there will be no cost, however if $m = 0$, i.e. the capital is perfectly immobile, then the cost will go to infinity which means it is not rational to move the capital. As will be shown in the coming section, the higher the degree of capital mobility, the lower the tax rate is.²⁰ The increasing property of cost function with respect to θ_t is associated with costly implementation of capital flight for citizens whereas convexity property implies marginal cost increases as the size of capital flight increases.

This budget constraint (2) can be rewritten as:

$$\dot{K}_t^1 = r_1 K_{1,t}^1 - C_t - (\tau_{1,t} r_1 K_{1,t}^1 + \tau_{2,t} r_2 K_{2,t}^1) - M(\theta_t^1, K_t^1, m) \quad (3)$$

From now on, equation (3) is used to represent the budget constraint.

3.2 Firm Problem

Each firm chooses amount of capital to maximize profits as rental rate of return, r , is given. That is, a firm solves

$$\max_{K_t} \pi = F(K_t) - rK_t$$

²⁰ Deveraux et.al. (2008) show corporate tax rates fall with the relaxation of capital controls in OECD countries in 1980s and 1990s. Winner (2005) argues that capital mobility decreases the capital tax burdens in OECD countries.

In each locality, the output level is calculated by A-K type production function:

$$F(K_t) = AK_t$$

where A is the technology parameter, K_t is the capital level per citizen at time t .

The first order condition to profit maximization implies the marginal product of capital, in other words,

$$F'(K_t) = r$$

Since the production function is A-K type, marginal product of capital is equal to the technology level.

$$F'(K_t) = A$$

In addition, the owners of the firms are the households, and the profit coming from the firm is zero.²¹

3.3 Governments

There are two levels of government: local governments and central government. Local governments behave as policy-making governments by choosing the policy variables, whereas central government is a passive government, which only determines the rule for redistribution.

3.3.1 Local Governments (Policy-making government)

Politicians who care about not only citizens but also their own self-interests carry out policy-making government. So, the local government may be fully benevolent

²¹ Combining the first order condition of the firm problem with A-K type production function gives the following:

$$F'(K_t) = r = A$$

The profit of the firm:

$$\pi = F(K_t) - rK_t = AK_t - AK_t = 0$$

or fully selfish or between these two. This study omits the part how or why the politician is selected, which implies the political economy part is mostly missing. However, it is allowed to put aside a share of tax revenue for the politician's own self interested purposes such as re-election purposes, etc. (Lockwood, 2006) Local government maximizes his objective function subject to law of motion for capital and instantaneous balanced budget constraint.

The lifetime utility of the local politician is as follows:

$$\begin{aligned}
V &= (1 - L)U + L \left(\int_0^\infty e^{-\rho t} [\ln R_{1,t}] \right) \\
&= (1 - L) \int_0^\infty e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}] dt \\
&\quad + L \left(\int_0^\infty e^{-\rho t} [\ln R_{1,t}] \right) \tag{4}
\end{aligned}$$

where U is the lifetime utility of a citizen, C_t^* is the consumption level decided by the citizen in citizen's problem and $R_{1,t}$ is the amount of tax revenue that is used for self interested purposes by politicians at time t . $L \in [0,1]$ is given exogenously which represents the degree of selfishness of the politician. In the literature, this parameter is known as rent seeking parameter (Lockwood, 2006; Edwards and Keen, 1996; Rauscher, 1998). If $L = 0$, the government do not put aside any tax revenue, so the government gets utility only from the utility of citizens, i.e., the government is fully benevolent. If $L = 1$, the government determines policy variable just looking at his own spending, i.e. the politician is fully selfish or self-caring.

Local governments maximize their objective function to choose tax rate ($\tau_{1,t}$), levied on capital income, public good level ($G_{1,t}$) that they will spend and rent-seeking variable ($R_{1,t}$) that they will use. In other words, the choice variables are $\tau_{1,t}, G_{1,t}, R_{1,t}$ for local government problem.

The law of motion for capital is as follows:

$$K'_{1,t} = Y_t - C_t^* - (A\tau_{1,t}K_{1,t}) - M(\theta_t^1, K_{1,t}, m) \quad (5)$$

where Y_t is A-K type production function, $K_{1,t}$ is the level of capital taxed in that jurisdiction and C_t^* is the level of consumption level decided by the citizen. $A\tau_{1,t}K_{1,t}$ is amount of tax revenue which is fully transferred to central government and $M(\theta_t^1, K_{1,t}, m)$ is the cost function as in the individual problem.

As explained in the individual problem, capital is mobile and there are two types of capital for each point in time, $K_{1,t}^1$ (capital at home jurisdiction) and $K_{1,t}^2$ (capital at foreign jurisdiction). Since the existence of two localities is assumed, the level of capital taxed by that locality is as follows:²²

$$K_{1,t} \equiv K_{1,t}^1 + K_{1,t}^2 = (1 - \theta_t^1)K_t^1 + \theta_t^2 K_t^2$$

In addition to the law of motion for capital, there is a balanced budget constraint, that should hold for each point in time, t . It is as follows:

$$G_{1,t} + R_{1,t} = N_{1,t} \quad (6)$$

where $N_{1,t}$ is the amount of transfers sent by central government. The source of these transfers is tax revenue, collected by the local governments. The interpretation of this equation is that local government use transfers either for public good provision or for its own political concerns. The transfer amount is decided with a rule by central government.

²² See Appendix A for detailed discussion

3.3.2. Central Government

Central government has an indirect role in fiscal policy; it only decides the transfer rule parameters. In this study, for simplicity it is assumed to exist only two geographically distinct but symmetric localities. Central government does not solve an optimization problem, his only aim is to find feasible values for redistributive parameters and distribute transfers to localities accordingly.

Assume there is a common pool, that all the localities drop their tax revenue into that pool and central government decides which locality should get how much tax revenue from that pool according to a linear redistribution rule. This common pool can be represented as:

$$\tau_{1,t}K_{1,t} + \tau_{2,t}K_{2,t} = N_{1,t} + N_{2,t} \quad (7)$$

3.4 Redistribution Mechanism

One way of reducing the fiscal imbalances is introducing the redistribution to the model. In developing countries, lack of proper fiscal institutional mechanism amplifies the effects of vertical and horizontal imbalances onto welfare. Ma (1997) examines 9 countries and concludes that an effective transfer mechanism should include four basic criteria: revenue adequacy, transparency and stability, local tax effort, equity. Revenue adequacy criterion is needed in transfer mechanisms because local jurisdictions have some responsibilities to citizens and in order to carry out these, they need sufficient resources. Transparency and stability criterion should exist for local governments to prepare their budget. Ma (1997) states that redistribution formulas should be stable for few years to make long-term local plans. The other criterion is local tax effort and expenditure control. The objective of this criterion is to make fiscal discipline by providing maximum level of tax efforts and not allowing fiscal deficits. The last criterion that Ma (1997) states is equity. The amounts of transfers should change as local fiscal needs and local fiscal

capacity change. Sanguinetti and Tomassi (2004) show that in order to promote fiscal efficiency and fiscal discipline among local governments, a transfer rule is preferred to discretion. Based on these findings, Akin, Bulut-Cevik and Neyapti (2016) construct a redistribution mechanism depending on equity and efficiency properties. Efficiency part aims the fiscal discipline by targeting the tax revenue. Equity part aims to destroy the horizontal imbalances between localities. In this study, this redistribution rule is taken with a slight change: Akin et. al. (2016) focus on tax collection effort in their rule while in this model tax revenue and tax revenue target is formed because unlike Akin et. al. (2016) tax collection effort is not introduced in our model. Instead of observed tax collection effort, actual tax revenue level is used. Then the redistribution rule becomes as follows:

$$N_{1,t} = p[\underbrace{\tau_{1,t}K_{1,t}}_{\text{Efficiency}} - \tilde{T}_t] + \varphi[\underbrace{\tilde{Y}_t - AK_{1,t}}_{\text{Equity}}] \quad (8)$$

where p is the punishment parameter and φ is the income compensation parameter. \tilde{T}_t is the tax revenue target level and \tilde{Y}_t is the income target level that are set exogenously. For instance, if a locality cannot reach tax revenue target level then central government punishes the locality and decreases the transfer amount with a degree of p . So the parameter p can be called ‘punishment parameter’. Also, if a locality cannot reach the income target level then the government increases the transfer amount with a degree of φ in order to decrease the horizontal imbalances. So the parameter φ can be called ‘income compensation parameter’ (Akin et.al., 2016)

The part $p[\tau_{1,t}K_{1,t} - \tilde{T}_t]$ is the efficiency part since the aim of inclusion of this equation in the redistributive rule is increasing the efforts of localities by punishing the under provision of tax collecting different from their potential. In other words, efficiency part provides the fiscal discipline by targeting the tax revenue level. Also

the part $\varphi[\check{Y}_t - AK_{1,t}]$ is the equity part since the aim of this equation is equalization among localities in terms of their income levels. In other words, equity part balances the localities for their revenue adequacy.

3.5 Summary

This section briefly explains the summary of whole model; i.e. who solves which problem under which constraint and when. As stated at the beginning of this chapter, there assumed to be two localities and the aim of the central government is to implement redistribution rule and decide the related parameters according to balanced budget rule as follows:

$$\begin{aligned}
\tau_{1,t}K_{1,t} + \tau_{2,t}K_{2,t} &= N_{1,t} + N_{2,t} \\
&= p[\tau_{1,t}K_{1,t} - \check{T}_t] + \varphi[\check{Y}_t - AK_{1,t}] + p[\tau_{2,t}K_{2,t} - \check{T}_t] \\
&\quad + \varphi[\check{Y}_t - AK_{2,t}]
\end{aligned} \tag{9}$$

This constraint shows that the amounts of transfers are equal to the tax revenue collected from the citizens. Since tax rate and capital levels are known from the citizen problem, and also targeted values are set exogenously, redistributive rule parameters can be found.²³

After announcing the redistribution rule, local governments determine the fiscal policy variables to maximize a weighted utility of local citizens and its rent-seeking motive. In this decentralized fiscal system, the governments may not be fully benevolent because of the inclusion of rent-seeking variable. The objective function of the local government is as follows:

$$(1 - L) \left(\int_0^\infty e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}] \right) + L \left(\int_0^\infty e^{-\rho t} [\ln R_{1,t}] \right)$$

²³ Rule parameters can be found as a weight, since there is one equation with two unknowns.

where $L \in [0,1]$ is the degree of selfishness of the politician and $s \in [0,1]$ is the degree of positive spillovers. Local governments maximize the above objective function and determine level of public good, the share of transfer amount that will be used for the local government's self interested purposes and tax rate, i.e. $G_{1,t}, R_{1,t}, \tau_{1,t}$

The constraints of local governments are budget balance of the jurisdiction, capital accumulation rule for the same jurisdiction and non-negativity constraints:

$$\begin{aligned}
G_{1,t} + R_{1,t} &= N_{1,t} \\
\dot{K}_{1,t} &= Y_t - C_t^* - (A\tau_{1,t}K_{1,t}) - M(\theta_t^1, K_{1,t}, m) \\
\theta_t^1 &\in [0,1] \\
\text{Given } K_{1,0} \text{ and } C_t^* > 0, K_{1,t} > 0
\end{aligned}$$

After the governments choose their policy variables and announce them, citizens determine the consumption and saving levels by maximizing their lifetime utility subject to flow budget constraint, which looks like as below:

$$\max_{\{C_t, K_t^1\}} \int_0^{\infty} e^{-\rho t} [\ln C_t + \ln G_{1,t} + s \ln G_{2,t}] dt$$

subject to

$$\begin{aligned}
\dot{K}_t^1 &= (1 - \tau_{1,t})r_1K_{1,t}^1 + (1 - \tau_{2,t})r_2K_{2,t}^1 - C_t - M(\theta_t^1, K_t^1, m) \\
\theta_t^1 &\in [0,1] \\
\text{Given } K_0^1, K_t^1 > 0 \text{ and } C_t > 0
\end{aligned}$$

The equilibrium concept used here is similar with Ortigueira et.al. (2012), Krusell and Rios-Rull (1999) and Klein et. al. (2008). The information description of how public and private sectors interact precipitates the equilibrium concept. This study

focuses on Markov-perfect Nash equilibrium of this economy by a continuum of households and governments that act sequentially.²⁴

Another important point is that the governments foresee their future behaviors when choosing current levels of tax rate, public good level and rent seeking level. In other words, for each point in time, t , after central government decides the transfer amounts, local government decides the tax rate, public good level and rent seeking level. Once that choice is publicly known, consumers choose consumption and saving levels. Governments can be considered as Stackelberg players and therefore can await the effects of current fiscal policy on citizen's decisions. It can be also expressed as that Markov Perfect Nash Equilibrium²⁵ for this model is as follows:

- i) Central government decides the redistribution rule parameters, p and φ , satisfying equation (9)
- ii) After redistributive rule parameters can be observable by local governments, local government maximizes his objective function (4) to decide the fiscal policy variables, $\tau, G(K), R(K)$
- iii) After everybody observes policy variables $\tau, G(K), R(K)$ and redistributive rule parameters, p and φ , citizens maximize their lifetime utility (1) in order to determine consumption level $C(K)$ and level of capital that is rented from neighbor jurisdiction $\theta(K)$
- iv) Firms also maximize their profit function

is a Markov Perfect Nash Equilibrium

²⁴ In the literature, this type of equilibrium is also called 'government-moves-first Markov-perfect equilibrium' (Klein et.al., 2003 and 2008; Ortigueira, 2006)

²⁵ This equilibrium definition can also be considered as Feedback-Nash Equilibrium under Closed-Loop

CHAPTER 4

SOLUTION

In the model part, the interactions between central government, local governments and citizens are already explained. After central government announces its redistribution policy, local governments decide the fiscal policy. Then given these levels, citizens determine their consumption and saving amounts. To derive the solution of this game, backward induction method is used. Analytic solution can be found with the help of MATLAB.

As explained in the previous chapter, redistribution mechanism has two properties: equity and efficiency. Our aim is to solve the models and compare the levels of welfare for these properties separately. In order to make comparisons, the model is solved case by case, in the coming sections. The difference between these models comes from the redistribution rule set-up. In the first case, redistribution rule has only efficiency property, in the second case it has only equity case and in the third case, it has both properties; equity and efficiency. In the last case, there is no redistribution rule; the local governments spend what they get from citizens as tax revenue.

Redistribution mechanism is decided by the central government, but local government knows before the announcement so instead of discretionary transfers, rule based redistribution mechanism is directly written in the local government problem. Citizen's problem does not change for each section because redistribution rule only affects the government problems. Another important property that simplifies the model is the symmetricity of the local governments as a benchmark

case. This assumption with tax competition leads to equal rates of tax as Nash equilibrium. Wildasin (1988) obtains Nash equilibria for jurisdictions with fiscal competition. As a special case, he examines the variables under identical jurisdictions with capital taxation and finds equal public expenditure levels, tax rates and capital levels at Nash equilibrium. Although the aim of Wilson (1991) is to obtain Nash equilibrium between two different regions in size under mobile capital and capital taxation, he also shows Nash equilibrium between two identical regions and finds equal level of tax rates and local public good levels. The reason behind these findings is as follows: An increase in tax rate of jurisdiction 'A' drives capital out of 'A' and into other localities since all jurisdictions are symmetric. This causes locality 'A' to lose its resources. So, jurisdiction 'A' has no incentive to increase its tax rate. Hence, if tax rates of symmetric jurisdiction 'A' and 'B' are equal to each other, then neither jurisdiction has an incentive to change its tax rate.

Basar and Olsder (1999) show a way to solve Stackelberg differential games. Since there is a leader and a follower, they are interacting with each other sequentially. So follower's (citizen) best responses should be imposed as constraints to the leader's (government) problem. Alternatively, Xie (1997) proposes that in time consistent policies, analytic solutions for optimal values belonging to the follower's model can be directly substituted to the leader's model without dealing with best responses. According to the solution of local government problem, optimal tax rate is independent of time, which implies time consistent government policy. Thus, in this analysis, latter type of solution method is preferred.

4.1 No Equity in Redistribution Rule ($\varphi = 0$)

4.1.1. Citizen Problem:

Citizen's problem, which is maximizing his lifetime utility subject to flow budget constraint, is as follows:

$$U = \max_{\{\theta_t^1, C_t, K_t^1\}} \int_0^{\infty} e^{-\rho t} [\ln C_t + \ln G_{1,t} + s \ln G_{2,t}] dt$$

subject to

$$\dot{K}_t^1 = r_1 K_t^1 - C_t - (\tau_{1,t} r_1 K_{1,t}^1 + \tau_{2,t} r_2 K_{2,t}^1) - M(\theta_t^1, K_t^1, m)$$

$$\theta_t^1 \in [0,1], K_t^1 > 0, C_t > 0$$

given $K_0^1, G_{1,t}, G_{2,t}, \tau_{1,t}, \tau_{2,t}$. In addition, $K_{2,t}^1 = \theta_t^1 K_t^1, K_{1,t}^1 = (1 - \theta_t^1) K_t^1$.

Output is A-K type model and firm's problem implies that marginal rate for return is equal to each jurisdiction since technology levels are the same, i.e. $r_1 = r_2$.

The Hamiltonian of this problem becomes:

$$\begin{aligned} \mathcal{H} = & \ln C_t + (1 - s) \ln G_{1,t} + s \ln G_{2,t} \\ & + \mu_t \left(r_1 K_t^1 - C_t - \tau_{1,t} (1 - \theta_t^1) r_1 K_t^1 - \theta_t^1 \tau_{2,t} r_2 K_t^1 \right. \\ & \quad \left. - K_t^1 (\theta_t^1)^2 / m \right) \end{aligned}$$

The first order conditions are as follows:

$$\frac{\partial \mathcal{H}_t}{\partial C_t} = \frac{1}{C_t} - \mu_t = 0 \quad \Rightarrow \quad \mu_t = \frac{1}{C_t} \quad \Rightarrow \quad \dot{\mu}_t = -\frac{\dot{C}_t}{C_t^2} \quad (9)$$

$$\frac{\partial \mathcal{H}_t}{\partial \theta_t^1} = \mu_t \left[\tau_{1,t} r_1 K_t^1 - \tau_{2,t} r_2 K_t^1 - \frac{2K_t^1 \theta_t^1}{m} \right] = 0 \quad (10)$$

$$\frac{\partial \mathcal{H}_t}{\partial K_t^1} = \mu_t \rho - \dot{\mu}_t = \mu_t \left(r_1 - \tau_{1,t} r_1 (1 - \theta_t^1) - \theta_t^1 \tau_{2,t} r_2 - (\theta_t^1)^2 / m \right) \quad (11)$$

Under the assumption of $K_t^1 > 0$ and $r_1 = r_2 = r$, (10) will imply

$$\theta_t = \frac{mr}{2} [\tau_{1,t} - \tau_{2,t}]$$

By using equation (9), equation (11) gives the Euler equation

$$\frac{\dot{C}}{C} = r [1 - \tau_{1,t} (1 - \theta_t^1) - \theta_t^1 \tau_{2,t}] - (\theta_t^1)^2 / m - \rho$$

Budget constraint can be rewritten as:

$$\begin{aligned} \dot{K}_t^1 &= \left[r [1 - \tau_{1,t} (1 - \theta_t^1) - \tau_{2,t} \theta_t^1] - (\theta_t^1)^2 / m \right] K_t^1 - C_t \\ \Rightarrow \frac{\dot{K}_t^1}{K_t^1} &= \underbrace{\left[r [1 - \tau_{1,t} (1 - \theta_t^1) - \tau_{2,t} \theta_t^1] - (\theta_t^1)^2 / m \right]}_{\chi} - \frac{C_t}{K_t^1} \end{aligned} \quad (12)$$

So,

$$\frac{\dot{C}}{C} = \chi - \rho \Rightarrow C_t = C_o e^{(\chi - \rho)t} \quad (13)$$

Transversality Condition is

$$\lim_{t \rightarrow \infty} K^1(t) e^{(-\int_0^t r(s) [1 - \tau(s)(1 - \theta(s)) - \tau^f(s)\theta(s)] - \theta(s)^2 / m) ds} = 0$$

Under given tax rates, $r = A$ and θ is a function of tax rates, rate of return and exogenous capital mobility, transversality condition becomes as follows:

$$\lim_{t \rightarrow \infty} K^1(t) e^{-\chi t} = 0$$

In A-K type endogenous growth models, there is growth in this economy without transitional dynamics, so transversality condition should be satisfied which implies the necessity of bounded lifetime utility assumption. In addition, positive

consumption growth is added in order not to cease existence of the economy. (Acemoglu, 2009)

i. Positive Consumption Growth:

$$\frac{\dot{C}}{C} = \chi - \rho > 0 \Rightarrow A[1 - (1 - \theta^1)\tau_1 - \theta^1\tau_2] - (\theta^1)^2/m - \rho > 0$$

ii. Bounded Utility:

$$0 < \frac{\dot{C}}{C} < \chi$$

This condition is already satisfied since $\frac{\dot{C}}{C} = \chi - \rho$ and $\rho > 0$.

Proposition: The growth rate of capital is equal to the growth rate of consumption.

Proof: From equation 12 and 13,

$$\dot{K}^1 = \chi K^1 - C(0)e^{(\chi-\rho)t} \quad (14)$$

Equation (14) is first order, non-autonomous linear differential equation in $K^1(t)$.

²⁶ Hence,

$$\begin{aligned} K^1(t) &= K^1(0)e^{\chi t} - e^{\chi t} \int_0^t e^{-\chi s} C(0)e^{(\chi-\rho)s} ds \\ &= K^1(0)e^{\chi t} - C(0)e^{\chi t} \left[\frac{1}{\rho} - \frac{e^{-\rho t}}{\rho} \right] \\ &= e^{\chi t} \left[\underbrace{K^1(0) - \frac{C(0)}{\rho}}_{=0 \text{ because of TVC}^{27}} \right] + \frac{C(0)}{\rho} e^{(\chi-\rho)t} \quad (15) \end{aligned}$$

²⁶ If $\dot{z}(t) = az(t) + b(t)$ then $z(t) = z_0 e^{at} + e^{at} \int_0^t e^{-as} b(s) ds$ for some constant z_0 chosen to satisfy boundary conditions. (Acemoglu, 2009) For equation (14), $a = \chi$ and $b(t) = -C(0)e^{(\chi-\rho)t}$

²⁷ Substitute $K(t)$ in equation (15) into Transversality Condition;

$$\lim_{t \rightarrow \infty} K^1(t)e^{-\chi t} = \left[e^{\chi t} \left[K^1(0) - \frac{C(0)}{\rho} \right] + \frac{C(0)}{\rho} e^{(\chi-\rho)t} \right] e^{-\chi t}$$

Thus, $C(t) = \rho K^1(t)$

■

Proposition: The growth rates of consumption, capital and output are all constant at all points in time.

Proof: It is obvious since growth rate of consumption, capital and output are all the same and equal to $\chi - \rho$. And χ depends on pre-determined variables for the citizen problem at time t .

4.1.2. Local Government Problem:

As stated before, this study aims to find welfare properties of a specific linear redistribution mechanism. Local governments choose policy variables independently, simultaneously but non-cooperatively. For this case, they cannot directly use their own tax revenue, but transfers given by central government. And they use these transfers either for public good or for their own self-interested purposes. This case differentiates in the redistribution mechanism set-up, in which only efficiency part is included, so equity part is omitted.

$$= \left[\begin{array}{c} \left(K^1(0) - \frac{C(0)}{\rho} \right) + \\ \frac{C(0)}{\rho} e^{-\rho t} \end{array} \right] = 0$$

So,

$$\lim_{t \rightarrow \infty} K^1(0) - \frac{C(0)}{\rho} = 0 \text{ implies } K^1(0) - \frac{C(0)}{\rho} = 0$$

And, $\lim_{t \rightarrow \infty} \frac{C(0)}{\rho} e^{-\rho t} = 0$ is already satisfied.

$$V = \max_{\{G_{1,t}, \tau_{1,t}, R_{1,t}\}} (1-L) \int_0^\infty e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}] \\ + L \int_0^\infty e^{-\rho t} [\ln R_{1,t}] dt$$

subject to

$$G_{1,t} + R_{1,t} = p[\tau_{1,t}K_{1,t} - \tilde{T}_t]$$

$$K_{1,t}' = AK_{1,t} - C_t - A(\tau_{1,t}K_{1,t}) - K_{1,t} \frac{(\theta_t^1)^2}{m}$$

After substituting the first constraint into the objective function ($G_{1,t} = p[\tau_{1,t}K_{1,t} - \tilde{T}_t] - R_{1,t}$), the Hamiltonian is as follows:

$$\mathcal{H} = (1-L)[\ln C_t^* + \ln(p[\tau_{1,t}K_{1,t} - \tilde{T}_t] - R_{1,t}) + s \ln G_{2,t}] + L[\ln R_{1,t}] \\ + \mu_t \left(AK_{1,t} - C_t - A(\tau_{1,t}K_{1,t}) - K_{1,t} \frac{(\theta_t^1)^2}{m} \right)$$

We know $K_{1,t} = (1 - \theta_t^1)K_t^1 + \theta_t^2 K_t^2$ which is level of capital in that locality. In addition, from citizen's problem we know $C_t^* = \rho K_t^1$, $\theta = (\tau_1 - \tau_2) \frac{mr_1}{2}$ and $K_t^1 = K_0^1 e^{(\chi - \rho)t}$ where $\chi = A(1 - \tau_1) + (\tau_1 - \tau_2) \frac{mr_1}{2} \left[A - \frac{mr_1}{2} \right]$

By adding above findings, first order conditions will be as follows:

$$\frac{\partial \mathcal{H}_t}{\partial R_{1,t}} = \frac{(1-L)}{G_{1,t}} (-1) + \frac{L}{R_{1,t}} = 0 \Rightarrow \frac{G_{1,t}}{R_{1,t}} = \frac{(1-L)}{L}$$

$$\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} = \frac{(1-L)}{C_t^*} \rho \frac{\partial K_{1,t}}{\partial \tau_{1,t}} + \frac{(1-L)}{G_{1,t}} \left[\frac{\partial K_{1,t}}{\partial \tau_{1,t}} p(\tau_{1,t} - \tilde{t}) + pK_{1,t} \right] \\ + \mu_t \frac{\partial K_{1,t}}{\partial \tau_{1,t}} \left(A - \rho - A\tau_{1,t} - \frac{(\theta_t^1)^2}{m} \right) \\ + \mu_t \left(-AK_{1,t} - 2\theta_t^1 K_{1,t} / m \frac{\partial \theta_t^1}{\partial \tau_{1,t}} \right) = 0$$

$$\begin{aligned}\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= \frac{(1-L)}{C_t} \rho + \frac{(1-L)}{G_{1,t}} [p(\tau_{1,t} - \tilde{t})] + \mu_t \left(A - \rho - A\tau_{1,t} - \frac{(\theta_t^1)^2}{m} \right) \\ &= \rho\mu_t - \dot{\mu}_t\end{aligned}$$

Also, note that

$$\begin{aligned}\frac{\partial K_{1,t}}{\partial \tau_{1,t}} &= (1 - \theta_t^1) K_t^1 t \frac{(\tau_1 - \tau_2) m(A)^2}{2} - A(1 - \theta_t^1) K_t^1 + \theta_t^2 K_t^2 t \frac{(\tau_1 - \tau_2) m(A)^2}{2} \\ &\quad - \frac{mA}{2} K_t^1 - \frac{mA}{2} K_t^2\end{aligned}$$

Symmetric jurisdiction property with tax competition leads to equality of tax rates as a Nash equilibrium ($\tau_1 = \tau_2$). When Nash equilibrium in tax rates ($\tau_1 = \tau_2$) and symmetric jurisdictions assumption are imposed to the first order conditions, the following equations are observed:

$$\begin{aligned}\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= -A(1-L)(1+m) + \frac{(1-L)}{G_{1,t}} pK_{1,t} \\ &\quad - \frac{(1-L)}{G_{1,t}} (1+m)A \underbrace{K_{1,t} [p(\tau_{1,t} - \tilde{t})]}_{G_{1,t} + R_{1,t} \text{ from budget constraint}} \\ &\quad - A\mu_t K_{1,t} [1 + (1+m)(A - \rho - A\tau_{1,t})] = 0\end{aligned}$$

$$\begin{aligned}\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= (1-L) + \frac{(1-L)}{G_{1,t}} \underbrace{K_{1,t} [p(\tau_{1,t} - \tilde{t})]}_{G_{1,t} + R_{1,t} \text{ from budget constraint}} + \mu_t \underbrace{K_{1,t} (A - \rho - A\tau_{1,t})}_{\dot{K}_t} \\ &= \rho\mu_t K_{1,t} - \dot{\mu}_t K_{1,t}\end{aligned}$$

Then,

$$\begin{aligned}\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= -A(1+m)(1-L) - A(1+m) + \frac{(1-L)}{G_{1,t}} pK_{1,t} \\ &\quad - A\mu_t K_{1,t} \left((1+m)(A - \rho - A\tau_{1,t}) + 1 \right) = 0\end{aligned}$$

$$\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} = 1 + (1 - L) + \mu_t \dot{K}_{1,t} = \rho \mu_t K_{1,t} - \dot{\mu}_t K_{1,t} \quad (16)$$

Multiply both sides of equation (16) with $e^{-\rho t}$ then integrate with respect to time (t):

$$\mu_t K_{1,t} = \frac{2 - L}{\rho} \quad (17)$$

After substituting equation (17) into the first order conditions, we have;

$$G_{1,t} = \frac{p\rho(1 - L)}{A^2(1 + m)(2 - L)(1 - \tau)} K_{1,t} \quad (18)$$

$$R_{1,t} = \frac{p\rho L}{A^2(1 + m)(2 - L)(1 - \tau)} K_{1,t} \quad (19)$$

Put equation (18) and (19) to the budget constraint which is:

$$G_{1,t} + R_{1,t} = \frac{p\rho}{A^2(1 + m)(2 - L)(1 - \tau_1)} K_{1,t} = K_{1,t} [p(\tau_1 - \tilde{t})]$$

By simplifying the above equation, we can find the optimal tax rate by the help of MATLAB. MATLAB gives two roots for optimal tax rate. Under specific parameters²⁸, the first root gives plausible values as a tax rate.²⁹

²⁸ See Chapter 5 for the values of parameters in the model

²⁹ Second root is the negative of the first root for tax rate.

$$\tau_1(1) = \frac{\left((AL - 2A)(1 + m + m\tilde{t} + \tilde{t}) + \sqrt{\begin{matrix} (L - 2)(1 + m)(4\rho + A^2L) \\ -2A^2m + 4A^2\tilde{t} - 2A^2 \\ -2A^2\tilde{t}^2 + A^2L\tilde{t}^2 - 2A^2m\tilde{t}^2 \\ +A^2Lm - 2A^2L\tilde{t} + 4A^2m\tilde{t} \\ -2A^2Lm\tilde{t} + A^2Lm\tilde{t}^2 \end{matrix}} \right)}{2A(L - 2)(1 + m)}$$

$$\tau_1(2) = \frac{\left((2A - AL)(1 + m + m\tilde{t} + \tilde{t}) - \sqrt{\begin{matrix} (L - 2)(1 + m)(4\rho + A^2L) \\ -2A^2m + 4A^2\tilde{t} - 2A^2 \\ -2A^2\tilde{t}^2 + A^2L\tilde{t}^2 - 2A^2m\tilde{t}^2 \\ +A^2Lm - 2A^2L\tilde{t} + 4A^2m\tilde{t} \\ -2A^2Lm\tilde{t} + A^2Lm\tilde{t}^2 \end{matrix}} \right)}{2A(L - 2)(1 + m)}$$

4.1.3. Central Government Problem:

Central government has not got a direct role in determining fiscal policy, but an indirect role in deciding the redistribution rule parameters, for this case, only punishment parameter. The balanced budget constraint is:

$$\tau_{1,t}K_{1,t} + \tau_{2,t}K_{2,t} = p[\tau_{1,t}K_{1,t} - \tilde{T}_t] + p[\tau_{2,t}K_{2,t} - \tilde{T}_t]$$

Then solution for p for the plausible tax rate is:

$$p = \frac{\left((AL - 2A)(1 + m + m\tilde{t} + \tilde{t}) + \sqrt{\begin{matrix} (L - 2)(1 + m)(4\rho + A^2L) \\ -2A^2m + 4A^2\tilde{t} - 2A^2 \\ -2A^2\tilde{t}^2 + A^2L\tilde{t}^2 - 2A^2m\tilde{t}^2 \\ +A^2Lm - 2A^2L\tilde{t} + 4A^2m\tilde{t} \\ -2A^2Lm\tilde{t} + A^2Lm\tilde{t}^2 \end{matrix}} \right)}{2A(L - 2)(1 + m)} - \tilde{t}$$

4.2 No Efficiency in Redistribution Rule ($p = 0$)

4.2.1 Citizen Problem:

The difference between the cases arises in the redistribution mechanism, and citizens do not take into account transfers between governments. Hence citizen's problem is the same with the previous one.

4.2.2 Local Government Problem:

In this case, efficiency property in the redistribution rule is omitted and only equity property plays a role in the redistribution mechanism.

$$V = \max_{\{G_{1,t}, \tau_{1,t}, R_{1,t}\}} (1 - L) \int_0^\infty e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}] + L \int_0^\infty e^{-\rho t} [\ln R_{1,t}] dt$$

subject to

$$\begin{aligned}
G_{1,t} + R_{1,t} &= \varphi[\tilde{Y}_t - AK_{1,t}] \\
K'_{1,t} &= AK_{1,t} - C_t^* - A(\tau_{1,t}K_{1,t}) - K_{1,t} \frac{(\theta_t^1)^2}{m} \\
\theta_t^1 &\in [0,1], K_{1,t} > 0, C_t^* > 0
\end{aligned}$$

After substituting the first constraint into the objective function ($G_{1,t} = \varphi[\tilde{Y}_t - AK_{1,t}] - R_{1,t}$), the Hamiltonian is as follows:

$$\begin{aligned}
\mathcal{H} &= (1-L)[\ln C_t^* + \ln(\varphi[\tilde{Y}_t - AK_{1,t}] - R_{1,t})] + s \ln G_{2,t} + L[\ln R_{1,t}] \\
&\quad + \mu_t \left(AK_{1,t} - C_t - A(\tau_{1,t}K_{1,t}) - K_{1,t} \frac{(\theta_t^1)^2}{m} \right)
\end{aligned}$$

We know $K_{1,t} = (1 - \theta_t^1)K_t^1 + \theta_t^2 K_t^2$ which is level of capital in that locality. In addition, from citizen's problem we know $C_t^* = \rho K_t^1$, $\theta = (\tau_1 - \tau_2) \frac{mr_1}{2}$ and $K_t^1 = K_0^1 e^{(\chi - \rho)t}$ where $\chi = A(1 - \tau_1) + (\tau_1 - \tau_2) \frac{mr_1}{2} \left[A - \frac{mr_1}{2} \right]$

By adding above findings, first order conditions will be as follows:

$$\begin{aligned}
\frac{\partial \mathcal{H}_t}{\partial R_{1,t}} &= \frac{(1-L)}{G_{1,t}}(-1) + \frac{L}{R_{1,t}} = 0 \implies \frac{G_{1,t}}{R_{1,t}} = \frac{(1-L)}{L} \\
\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= \frac{(1-L)}{\rho K_{1,t}} \rho \frac{\partial K_{1,t}}{\partial \tau_{1,t}} + \frac{(1-L)}{G_{1,t}} \left[\frac{\partial K_{1,t}}{\partial \tau_{1,t}} \varphi[\tilde{y} - A] \right] \\
&\quad + \mu_t \frac{\partial K_{1,t}}{\partial \tau_{1,t}} \left(A - \rho - A\tau_{1,t} - \frac{(\theta_t^1)^2}{m} \right) \\
&\quad + \mu_t \left(-AK_{1,t} - 2\theta_t^1 K_{1,t} / m \frac{\partial \theta_t^1}{\partial \tau_{1,t}} \right) = 0 \\
\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= \frac{(1-L)}{\rho K_{1,t}} \rho + \frac{(1-L)}{G_{1,t}} [\varphi[\tilde{y} - A]] + \mu_t \left(A - \rho - A\tau_{1,t} - \frac{(\theta_t^1)^2}{m} \right) \\
&= \rho \mu_t - \dot{\mu}_t
\end{aligned}$$

Symmetric jurisdiction property with tax competition leads to equality of tax rates as a Nash equilibrium ($\tau_1 = \tau_2$). When Nash equilibrium in tax rates ($\tau_1 = \tau_2$) and symmetric jurisdictions assumption are imposed to the first order conditions, the following equations are observed:

$$\begin{aligned} \frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= -A(1-L)(1+m) - \frac{(1-L)}{G_{1,t}}(1+m)A \underbrace{K_{1,t}\varphi[\tilde{y}-A]}_{G_{1,t}+R_{1,t} \text{ from budget constraint}} \\ &\quad - A\mu_t K_{1,t} [1 + (1+m)(A - \rho - A\tau_{1,t})] = 0 \\ \frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= (1-L) + \frac{(1-L)}{G_{1,t}} \underbrace{K_{1,t}[\varphi[\tilde{y}-A]]}_{G_{1,t}+R_{1,t} \text{ from budget constraint}} + \mu_t \underbrace{K_{1,t}(A - \rho - A\tau_{1,t})}_{K_{1,t}} \\ &= \rho\mu_t K_{1,t} - \dot{\mu}_t K_{1,t} \end{aligned}$$

Then,

$$\begin{aligned} \frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= -A(1+m)(1-L) - A(1+m) - A\mu_t K_{1,t} \left((1+m)(A - \rho - A\tau_{1,t}) + 1 \right) \\ &= 0 \\ \frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= 1 + (1-L) + \mu_t K_{1,t} = \rho\mu_t K_{1,t} - \dot{\mu}_t K_{1,t} \quad (20) \end{aligned}$$

Multiply both sides of equation (20) with $e^{-\rho t}$ then integrate with respect to time (t):

$$\mu_t K_{1,t} = \frac{2-L}{\rho} \quad (21)$$

After substituting equation (21) into the first order conditions, we have;

$$\tau_1 = \frac{1}{A(1+m)}$$

$$R_{1,t} = \varphi L[\tilde{y} - A]K_{1,t}$$

$$G_{1,t} = \varphi(1 - L)[\tilde{y} - A]K_{1,t}$$

4.2.3. Central Government Problem:

Central government aims to satisfy the balanced budget constraint:

$$\tau_{1,t}K_{1,t} + \tau_{2,t}K_{2,t} = \varphi[\check{Y}_t - AK_{1,t}] + \varphi[\check{Y}_t - AK_{2,t}]$$

Then solution for φ is:

$$\varphi = \frac{1}{A(1 + m)(\tilde{y} - A)}$$

4.3. Full Redistribution Rule ($p \neq 0, \varphi \neq 0$)

4.3.1 Citizen Problem:

The difference between the cases arises in the redistribution mechanism, and citizens do not take into account transfers between governments. Hence citizen's problem is the same with the previous one.

4.3.2 Local Government Problem:

In this case, redistribution rule does not omit any property, it has both equity and efficiency properties.

$$V = \max_{\{G_{1,t}, \tau_{1,t}, R_{1,t}\}} (1-L) \int_0^{\infty} e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}] \\ + L \int_0^{\infty} e^{-\rho t} [\ln R_{1,t}] dt$$

subject to

$$G_{1,t} + R_{1,t} = \varphi[\tilde{Y}_t - AK_{1,t}] + p[\tau_{1,t}K_{1,t} - \tilde{T}_t]$$

$$K_{1,t} = AK_{1,t} - C_t^* - A(\tau_{1,t}K_{1,t}) - K_{1,t} (\theta_t^1)^2/m$$

$$\theta_t^1 \in [0,1], K_{1,t} > 0, C_t > 0$$

After substituting the first constraint into the objective function ($G_{1,t} = \varphi[\tilde{Y}_t - AK_{1,t}] + p[\tau_{1,t}K_{1,t} - \tilde{T}_t] - R_{1,t}$), the Hamiltonian is as follows:

$$\mathcal{H} = (1-L)[\ln C_t^* + \ln(\varphi[\tilde{Y}_t - AK_{1,t}] + p[\tau_{1,t}K_{1,t} - \tilde{T}_t] - R_{1,t}) + s \ln G_{2,t}] \\ + L[\ln R_{1,t}] + \mu_t \left(AK_{1,t} - C_t - A(\tau_{1,t}K_{1,t}) - K_{1,t} (\theta_t^1)^2/m \right)$$

We know $K_{1,t} = (1 - \theta_t^1)K_t^1 + \theta_t^2 K_t^2$ which is level of capital in that locality. In addition, from citizen's problem we know $C_t^* = \rho K_t^1$, $\theta = (\tau_1 - \tau_2) \frac{mr_1}{2}$ and $K_t^1 = K_0^1 e^{(\chi - \rho)t}$ where $\chi = A(1 - \tau_1) + (\tau_1 - \tau_2) \frac{mr_1}{2} \left[A - \frac{mr_1}{2} \right]$

By adding above findings, first order conditions will be as follows:

$$\frac{\partial \mathcal{H}_t}{\partial R_{1,t}} = \frac{(1-L)}{G_{1,t}}(-1) + \frac{L}{R_{1,t}} = 0 \Rightarrow \frac{G_{1,t}}{R_{1,t}} = \frac{(1-L)}{L}$$

$$\begin{aligned}
\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= \frac{(1-L)}{\rho K_{1,t}} \rho \frac{\partial K_{1,t}}{\partial \tau_{1,t}} + \frac{(1-L)}{G_{1,t}} \left[p K_{1,t} + \frac{\partial K_{1,t}}{\partial \tau_{1,t}} (p[\tau_{1,t} - \tilde{t}] + \varphi[\tilde{y} - A]) \right] \\
&\quad + \mu_t \frac{\partial K_{1,t}}{\partial \tau_{1,t}} \left(A - \rho - A\tau_{1,t} - \frac{(\theta_t^1)^2}{m} \right) \\
&\quad + \mu_t \left(-AK_{1,t} - \frac{2\theta_t^1 K_{1,t}}{m} \frac{\partial \theta_t^1}{\partial \tau_{1,t}} \right) = 0 \\
\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= \frac{(1-L)}{\rho K_{1,t}} \rho + \frac{(1-L)}{G_{1,t}} \left[p[\tau_{1,t} - \tilde{t}] + \varphi[\tilde{y} - A] \right] \\
&\quad + \mu_t \left(A - \rho - A\tau_{1,t} - \frac{(\theta_t^1)^2}{m} \right) = \rho\mu_t - \dot{\mu}_t
\end{aligned}$$

As in the previous cases, symmetric jurisdiction property with tax competition leads to equality of tax rates as a Nash equilibrium ($\tau_1 = \tau_2$). When Nash equilibrium in tax rates ($\tau_1 = \tau_2$) and symmetric jurisdictions assumption are imposed to the first order conditions, the following equations are observed:

$$\begin{aligned}
\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= -A(1-L)(1+m) - \frac{(1-L)}{G_{1,t}} (1+m) A \underbrace{K_{1,t} (p[\tau_{1,t} - \tilde{t}] + \varphi[\tilde{y} - A])}_{G_{1,t} + R_{1,t} \text{ from budget constraint}} \\
&\quad + \frac{(1-L)}{G_{1,t}} p K_{1,t} - A\mu_t K_{1,t} [1 + (1+m)(A - \rho - A\tau_{1,t})] = 0 \\
\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= (1-L) + \frac{(1-L)}{G_{1,t}} \underbrace{K_{1,t} [p[\tau_{1,t} - \tilde{t}] + \varphi[\tilde{y} - A]]}_{G_{1,t} + R_{1,t} \text{ from budget constraint}} + \mu_t \underbrace{K_{1,t} (A - \rho - A\tau_{1,t})}_{K_{1,t}} \\
&= \rho\mu_t K_{1,t} - \dot{\mu}_t K_{1,t}
\end{aligned}$$

Then,

$$\begin{aligned}
\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= -A(1+m)(1-L) - A(1+m) + \frac{(1-L)}{G_{1,t}} p K_{1,t} \\
&\quad - A\mu_t K_{1,t} \left((1+m)(A - \rho - A\tau_{1,t}) + 1 \right) = 0 \\
\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= 1 + (1-L) + \mu_t \dot{K}_{1,t} = \rho\mu_t K_{1,t} - \dot{\mu}_t K_{1,t} \quad (22)
\end{aligned}$$

Multiply both sides of equation (22) with $e^{-\rho t}$ then integrate with respect to time (t):

$$\mu_t K_{1,t} = \frac{2-L}{\rho} \quad (23)$$

After substituting equation (23) into the first order conditions, we have;

$$R_{1,t} = \frac{Lp\rho}{A(2-L)(1+(1+m)(A-A\tau_1))} K_{1,t} \quad (24)$$

$$G_{1,t} = \frac{(1-L)p\rho}{A(2-L)(1+(1+m)(A-A\tau_1))} K_{1,t} \quad (25)$$

Put equation (24) and (25) to the budget constraint which is:

$$\begin{aligned} G_{1,t} + R_{1,t} &= \frac{p\rho}{A(2-L)(1+(1+m)(A-A\tau_1))} K_{1,t} \\ &= K_{1,t} \left[p[\tau_{1,t} - \tilde{t}] + \varphi[\tilde{y} - A] \right] \end{aligned}$$

By simplifying the above equation, we can find the optimal tax rate by the help of MATLAB. MATLAB gives long and complicated two roots for optimal tax rate. Under specific parameters³⁰, the first root gives plausible values as a tax rate.³¹

4.3.3. Central Government Problem:

In this case, both equity and efficiency property is included in the balanced budget rule. As you can observe, there is one equation with two unknowns, so not direct solutions but relative values can be observed.³²

³⁰ See Chapter 5 for the values of parameters in the model

³¹ Second root is the opposite of first root in sign.

Balanced budget constraint is as follows:

$$\tau_{1,t}K_{1,t} = p[\tau_{1,t}K_{1,t} - \tilde{T}] + \varphi[\tilde{Y} - AK_{1,t}]$$

Assume φ is numeraire then p shows the relative weight of efficiency to equity property. The solution for p is

$$p = \frac{\tau_{1,t} - \tilde{y} + A}{\tau_{1,t} - \tilde{\tau}}$$

4.4. No Redistribution Rule

4.4.1 Citizen Problem:

The difference between these four cases arises in the redistribution mechanism, and citizens do not take into account whether there is a transfer rule or not, because this redistribution rule processes between governments. Hence, the citizen problem is the same with the other citizen problems.

4.4.2 Local Government Problem:

In this case, there is no redistribution rule, local governments use all the tax revenue, they get from the households. As in the redistribution mechanism, they use tax revenue either for public good or for their own self-interested purposes

³² This is similar with budget constraint in a simple utility maximization problem. Two prices for different goods are decreased to one price by assuming one price as a numeraire and then other shows the relative price of the good.

$$V = \max_{\{G_{1,t}, \tau_{1,t}, R_{1,t}\}} (1-L) \int_0^{\infty} e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}] \\ + L \int_0^{\infty} e^{-\rho t} [\ln R_{1,t}] dt$$

subject to

$$G_{1,t} + R_{1,t} = \tau_{1,t} K_{1,t}$$

$$K'_{1,t} = AK_{1,t} - C_t^* - A(\tau_{1,t} K_{1,t}) - K_{1,t} \frac{(\theta_t^1)^2}{m} \\ \theta_t^1 \in [0,1], K_{1,t} > 0, C_t^* > 0$$

After substituting the first constraint into the objective function ($G_{1,t} = \tau_{1,t} K_{1,t} - R_{1,t}$), the Hamiltonian is as follows:

$$\mathcal{H} = (1-L)[\ln C_t + \ln(\tau_{1,t} K_{1,t} - R_{1,t}) + s \ln G_{2,t}] + L[\ln R_{1,t}] + \mu_t \left(AK_{1,t} - C_t^* \right. \\ \left. - A(\tau_{1,t} K_{1,t}) - K_{1,t} \frac{(\theta_t^1)^2}{m} \right)$$

We know $K_{1,t} = (1 - \theta_t^1)K_t^1 + \theta_t^2 K_t^2$ which is level of capital in that locality. In addition, from citizen's problem we know $C_t^* = \rho K_t^1$, $\theta = (\tau_1 - \tau_2) \frac{mr_1}{2}$ and $K_t^1 = K_0^1 e^{(\chi - \rho)t}$ where $\chi = A(1 - \tau_1) + (\tau_1 - \tau_2) \frac{mr_1}{2} \left[A - \frac{mr_1}{2} \right]$

By adding above findings, first order conditions will be as follows:

$$\frac{\partial \mathcal{H}_t}{\partial R_{1,t}} = \frac{(1-L)}{G_{1,t}} (-1) + \frac{L}{R_{1,t}} = 0 \implies \frac{G_{1,t}}{R_{1,t}} = \frac{(1-L)}{L}$$

$$\begin{aligned}\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= \frac{(1-L)}{\rho K_{1,t}} \rho \frac{\partial K_{1,t}}{\partial \tau_{1,t}} + \frac{(1-L)}{G_{1,t}} \left[K_{1,t} + \frac{\partial K_{1,t}}{\partial \tau_{1,t}} (\tau_{1,t}) \right] \\ &\quad + \mu_t \frac{\partial K_{1,t}}{\partial \tau_{1,t}} \left(A - \rho - A\tau_{1,t} - \frac{(\theta_t^1)^2}{m} \right) \\ &\quad + \mu_t \left(-AK_{1,t} - 2\theta_t^1 K_{1,t}/m \frac{\partial \theta_t^1}{\partial \tau_{1,t}} \right) = 0\end{aligned}$$

$$\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} = \frac{(1-L)}{\rho K_{1,t}} \rho + \frac{(1-L)}{G_{1,t}} [\tau_{1,t}] + \mu_t \left(A - \rho - A\tau_{1,t} - \frac{(\theta_t^1)^2}{m} \right) = \rho \mu_t - \dot{\mu}_t$$

As in the previous cases, symmetric jurisdiction property with tax competition leads to equality of tax rates as Nash equilibrium ($\tau_1 = \tau_2$). When Nash equilibrium in tax rates ($\tau_1 = \tau_2$) and symmetric jurisdictions assumption are imposed to the first order conditions, the following equations are observed:

$$\begin{aligned}\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= -A(1-L)(1+m) - \frac{(1-L)}{G_{1,t}} (1+m)A \underbrace{\tau_{1,t} K_{1,t}}_{G_{1,t} + R_{1,t} \text{ from budget constraint}} \\ &\quad + \frac{(1-L)}{G_{1,t}} K_{1,t} - A\mu_t K_{1,t} [1 + (1+m)(A - \rho - A\tau_{1,t})] = 0\end{aligned}$$

$$\begin{aligned}\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} &= (1-L) + \frac{(1-L)}{G_{1,t}} \underbrace{\tau_{1,t} K_{1,t}}_{G_{1,t} + R_{1,t} \text{ from budget constraint}} + \mu_t \underbrace{K_{1,t} (A - \rho - A\tau_{1,t})}_{\dot{K}_t} \\ &= \rho \mu_t K_{1,t} - \dot{\mu}_t K_{1,t}\end{aligned}$$

Then,

$$\begin{aligned}\frac{\partial \mathcal{H}_t}{\partial \tau_{1,t}} &= -A(1+m)(1-L) - A(1+m) + \frac{(1-L)}{G_{1,t}} p K_{1,t} \\ &\quad - A\mu_t K_{1,t} \left((1+m)(A - \rho - A\tau_{1,t}) + 1 \right) = 0\end{aligned}$$

$$\frac{\partial \mathcal{H}_t}{\partial K_{1,t}} = 1 + (1-L) + \mu_t \dot{K}_{1,t} = \rho \mu_t K_{1,t} - \dot{\mu}_t K_{1,t} \quad (26)$$

Multiply both sides of equation (26) with $e^{-\rho t}$ then integrate with respect to time (t):

$$\mu_t K_{1,t} = \frac{2-L}{\rho} \quad (27)$$

After substituting equation (27) into the first order conditions, we have;

$$R_{1,t} = \frac{L\rho}{A(2-L)(1+(1+m)(A-A\tau_1))} K_{1,t} \quad (28)$$

$$G_{1,t} = \frac{(1-L)\rho}{A(2-L)(1+(1+m)(A-A\tau_1))} K_{1,t} \quad (29)$$

Put equation (28) and (29) to the budget constraint which is:

$$G_{1,t} + R_{1,t} = \frac{\rho}{A(2-L)(1+(1+m)(A-A\tau_1))} K_{1,t} = \tau_{1,t} K_{1,t}$$

By simplifying the above equation, we can find the optimal tax rate by the help of MATLAB. MATLAB gives two roots for optimal tax rate. Under specific parameters³³, the first root gives plausible values as a tax rate.³⁴

$$\tau_1(1) = \frac{\left((L-2)(1+A(1+m)) + \sqrt{(L-2)(L-4A+4\rho-4Am) + 4m\rho + A^2L - 4A^2m - 2A^2 - 2A^2m^2 + 2AL + A^2Lm^2 + 2ALm + 2A^2Lm - 2} \right)}{2A(L-2)(1+m)}$$

$$\tau_1(2) = \frac{\left((2-L)(1+A(1+m)) - \sqrt{(L-2)(L-4A+4\rho-4Am) + 4m\rho + A^2L - 4A^2m - 2A^2 - 2A^2m^2 + 2AL + A^2Lm^2 + 2ALm + 2A^2Lm - 2} \right)}{2A(L-2)(1+m)}$$

³³ See Chapter 5 for the values of parameters in the model

³⁴ Second root is the opposite of first root in sign

Since there is no redistribution rule and local governments spend what they take, central government has no role in this case. In other words, there is no central government problem.

4.5. Welfare Analysis

This study aims to find the welfare properties of equity and efficiency dimensions of a linear redistribution mechanism in a decentralized fiscal setting. In order to answer this question, welfare levels of citizens are obtained under different cases (*i.* no efficiency, *ii.* no equity, *iii.* full redistribution rule, *iv.* no redistribution rule).

4.5.1. No Equity in Redistribution Rule ($\varphi = 0$)

The welfare level of citizens is as follows:

$$U = \int_0^{\infty} e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}]$$

We also know $\frac{\dot{K}^1}{K^1} = \gamma = A(1 - \tau_1) - \rho$ and $K_t^1 = K_0^1 e^{\gamma t}$, $C_t^* = \rho K_0^1 e^{\gamma t}$

Note that, tax rate is time independent, only depends on exogenous parameters.³⁵

$$\int_0^{\infty} e^{-\rho t} \ln C_t^* = \frac{\ln \rho K_0^1}{\rho} + \frac{\gamma}{\rho^2}$$

where $\gamma = A(1 - \tau_1) - \rho$

$$\int_0^{\infty} e^{-\rho t} \ln G_{1,t} = \frac{\ln \hat{G}}{\rho} + \frac{\gamma}{\rho^2}$$

where $\gamma = A(1 - \tau_1) - \rho$ and $\hat{G} = \frac{p\rho(1-L)}{A^2(1+m)(2-L)(1-\tau_1)} K_0^1$

³⁵ This welfare analysis is similar with Chu and Yang's (2012) study

There is a symmetricity assumption between jurisdictions, which induces equal levels of public good (i.e. $G_{1,t} = G_{2,t}$)

$$U = \frac{2 + s}{\rho} \left[\ln(\rho K_o^1) + \frac{\gamma}{\rho} \right] + \frac{1 + s}{\rho} \left[\ln \frac{p(1 - L)}{A^2(1 + m)(2 - L)(1 - \tau_1)} \right]$$

where punishment parameter (p) and tax rate (τ_1) are endogenously determined³⁶

4.5.2. No Efficiency in Redistribution Rule ($p = 0$)

Although welfare equation of the citizens is the same, since policy variables are endogenously determined, the welfare value differs.

$$U = \int_0^{\infty} e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}]$$

We also know $\frac{\dot{K}^1}{K^1} = \gamma = A(1 - \tau_1) - \rho$ and $K_t^1 = K_0^1 e^{\gamma t}$, $C_t^* = \rho K_0^1 e^{\gamma t}$

Note that, tax rate is time independent as in the previous section, only depends on exogenous parameters.³⁷

$$\int_0^{\infty} e^{-\rho t} \ln C_t^* = \frac{\ln \rho K_o^1}{\rho} + \frac{\gamma}{\rho^2}$$

where $\gamma = A(1 - \tau) - \rho$

$$\int_0^{\infty} e^{-\rho t} \ln G_{1,t} = \frac{\ln \hat{G}}{\rho} + \frac{\gamma}{\rho^2}$$

where $\gamma = A(1 - \tau_1) - \rho$ and $\hat{G} = \varphi(1 - L)(\tilde{y} - A)K_o^1$

³⁶ See 4.2 for the detailed solutions

³⁷ This welfare analysis is similar with Chu and Yang's (2012) study

Symmetricity assumption implies the public good levels of each jurisdiction are equal to each other (i.e. $G_{1,t} = G_{2,t}$)

$$U = (2 + s) \left(\frac{\ln K_0^1}{\rho} + \frac{\gamma}{\rho^2} \right) + \frac{\ln \rho}{\rho} + \frac{1 + s}{\rho} [\ln \varphi(1 - L)(\tilde{y} - A)]$$

4.5.3. Full Redistribution Rule ($p \neq 0, \varphi \neq 0$)

The welfare level of citizens is as follows:

$$U = \int_0^\infty e^{-\rho t} [\ln C_t^* + \ln G_{1,t} + s \ln G_{2,t}]$$

We also know $\frac{K^1}{K^1} = \gamma = A(1 - \tau_1) - \rho$ and $K_t^1 = K_0^1 e^{\gamma t}$, $C_t^* = \rho K_0^1 e^{\gamma t}$

As in the previous cases,

$$\int_0^\infty e^{-\rho t} \ln C_t^* = \frac{\ln \rho K_0^1}{\rho} + \frac{\gamma}{\rho^2}$$

where $\gamma = A(1 - \tau) - \rho$

$$\int_0^\infty e^{-\rho t} \ln G_{1,t} = \frac{\ln \hat{G}}{\rho} + \frac{\gamma}{\rho^2}$$

where $\gamma = A(1 - \tau_1) - \rho$ and $\hat{G} = \frac{p\rho(1-L)}{A(2-L)[1+\rho m+A-A\tau_1]} K_0^1$

Symmetricity assumption implies the public good levels of each jurisdiction are equal to each other (i.e. $G_{1,t} = G_{2,t}$)

$$U = \frac{2 + s}{\rho} \left[\ln(\rho K_0^1) + \frac{\gamma}{\rho} \right] + \frac{1 + s}{\rho} \left[\ln \frac{p(1 - L)}{A(2 - L)[1 + \rho m + A - A\tau_1]} \right]$$

4.5.4. No Redistribution Rule

The welfare level of citizens is the same as follows:

$$U = \int_0^{\infty} e^{-\rho t} [\ln C_t + \ln G_{1,t} + s \ln G_{2,t}]$$

We also know $\frac{K^1}{K^1} = \gamma = A(1 - \tau_1) - \rho$ and $K_t^1 = K_0^1 e^{\gamma t}$, $C_t^* = \rho K_0^1 e^{\gamma t}$

As in the previous cases,

$$\int_0^{\infty} e^{-\rho t} \ln C_t^* = \frac{\ln \rho K_0^1}{\rho} + \frac{\gamma}{\rho^2}$$

where $\gamma = A(1 - \tau_1) - \rho$

$$\int_0^{\infty} e^{-\rho t} \ln G_{1,t} = \frac{\ln \hat{G}}{\rho} + \frac{\gamma}{\rho^2}$$

where $\gamma = A(1 - \tau_1) - \rho$ and $\hat{G} = \frac{\rho(1-L)}{A(2-L)[1+(1+m)(A-A\tau_1)]} K_0^1$

Symmetricity assumption implies the public good levels of each jurisdictions are equal to each other (i.e. $G_t = G_t^f$)

$$U = \frac{2+s}{\rho} \left[\ln(\rho K_0^1) + \frac{\gamma}{\rho} \right] + \frac{1+s}{\rho} \left[\ln \frac{\rho(1-L)}{A(2-L)[1+(1+m)(A-A\tau_1)]} \right]$$

CHAPTER 5

RESULTS

In the previous section, the analytical solutions of the models are solved and presented. In order to make policy implications, the effects of some parameters onto fiscal policy variables are examined in this section.

Most of the policy variables are too complicated to derive analytical comparative statistic results hence we resort to simulation analysis to interpret the findings. Hence, following point or range of values are taken for the exogenous variables. (See Table 5.1)

Table 5.1. Parameter Values

	Parameter Name	Value	Explanation
ρ	Discount Rate	0.01	Corresponds to yearly discount factor 0.99
A	Level of Technology	0.3376	$(K/Y \cong 2.962)$ US Data
K_0^1	Initial Capital	1	
L	Selfishness	[0,1]	'0' = government is fully benevolent, '1' = government is fully selfish
s	Positive Spillovers	[0,1]	'0'=citizens do not take any utility from neighbor's public good
m	Capital Mobility	[0,1000]	1000 represents an arbitrary big number
\tilde{t}	Targeted Rate	[0,0.5]	$\tilde{t} = \tilde{T}/K_t$
\tilde{y}		0.3714	Targeted income level is 10% above the existing level ($\tilde{y} = \tilde{Y}/K_t$)

5.1. Comparative Statics

5.1.1 No Equity in Redistribution Rule

Lemma 1: The findings for symmetric equilibrium are as follows:

- Optimal tax rate (τ_1) is independent of time.
- The public good level is a function of capital, tax rate and other exogenous parameter values

$$G_{1,t} = \frac{p\rho(1-L)}{A^2(1+m)(2-L)(1-\tau_1)} K_{1,t}$$

- The rent seeking variable is a function of capital, tax rate and other exogenous parameters

$$R_{1,t} = \frac{p\rho L}{A^2(1+m)(2-L)(1-\tau_1)} K_{1,t}$$

- Capital and consumption depends on initial capital and other exogenous parameters

$$\begin{aligned} K_t^1 &= K_0^1 e^{\chi t} \\ C_t &= \rho K_t^1 \end{aligned}$$

where $\chi = A - A\tau_1$

- The redistributive rule parameter (p) depends on selfishness parameter (L), degree of capital mobility (m), targeted tax rate ($\tilde{\tau}$), technology level (A) and discount rate (ρ)

$$p = f(A, L, m, \rho, \tilde{\tau})$$

Proof: See Section 4.1 for the solution.

As you can see from Lemma 1, optimal tax rate is independent of time and so depends only on some exogenous parameters. Under assigned parameter values, comparative statics analysis is performed.

- **The Effects of Capital Mobility**

In the model, capital is allowed to be mobile. Model allows capital mobility to take any value from zero (immobile capital) to infinity (perfect capital mobility),³⁸. Perfectly mobile capital, $m = \infty$, implies no transaction cost or other costs during the movement of capital. On the other hand, perfectly immobile capital, $m = 0$, implies expensive and difficult to move capital between localities.

As you can see from Figure 5.1, and also from the first order derivative of tax rate with respect to capital mobility, the relation between capital mobility and tax rate is negative. In other words, when the capital mobility increases, tax rate decreases. The intuition behind this finding is that higher capital mobility means that capital can move less costly. In this study, only revenue for governments comes with the capital income taxation; hence in order not to lose more capital, governments decrease their tax rate when capital mobility increases.

The relation between level of capital and degree of capital mobility is opposite of the relation between tax rate and degree of capital mobility. The reason lies in is the solution structure of capital.³⁹

³⁸ Any arbitrary big number, 100, is chosen. Bigger than this number is also run , but it shows no change in the relationships. In order to see relationships clearer, this number is chosen.

³⁹ The analytical solution of capital is: $K_t = K_0 e^{(A - A\tau - \rho)t}$ and $\frac{\partial K}{\partial \tau} < 0$. Level of capital is always positive and level of technology and time are also always positive, this implies the negative relation between capital and tax rate. Hence the effects of any exogenous parameters onto tax rate and onto level of capital will always be opposite.

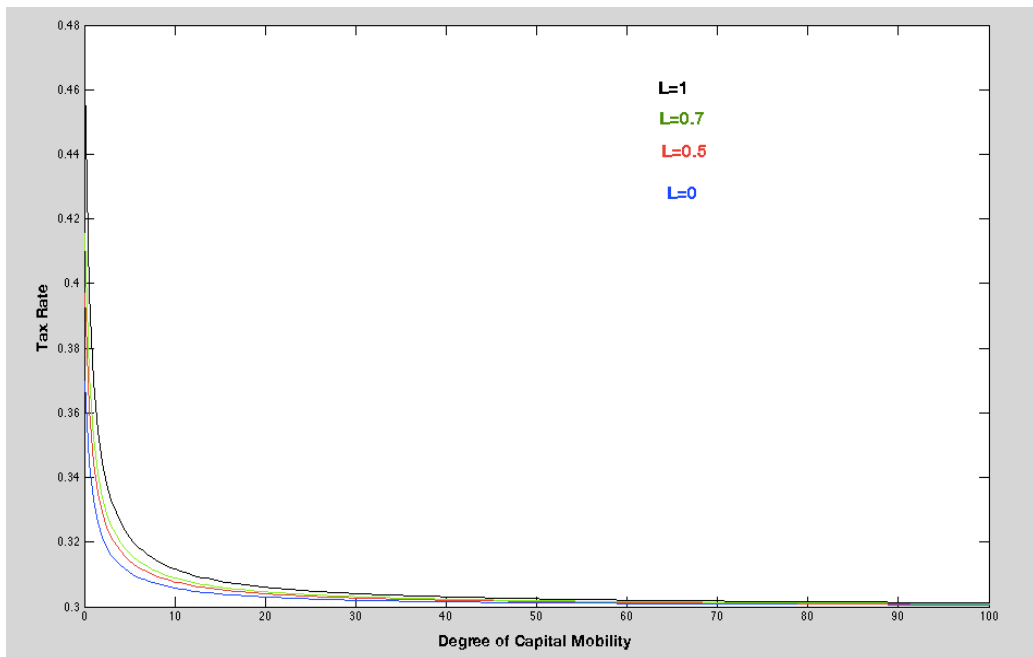


Figure 5.1. Graph of Tax Rate and Degree of Capital Mobility

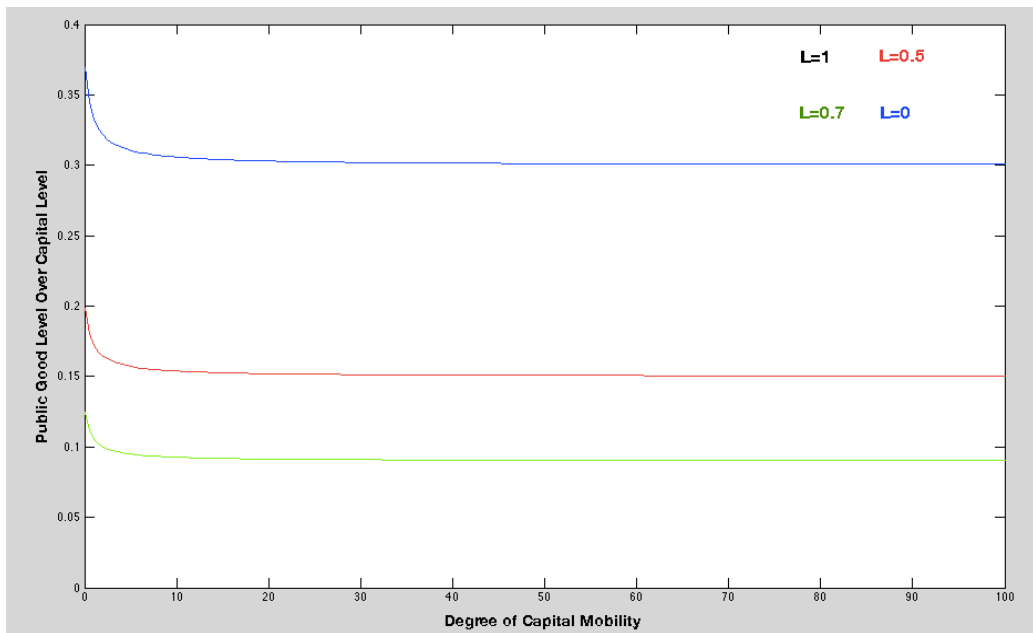


Figure 5.2. Graph of Public Good Level Over Capital Level and Degree of Capital Mobility

As you can see from Figure 5.2 and from the first order derivative of public good level with respect to capital mobility, there is a negative relationship between level of public good and degree of capital mobility. In other words, as capital becomes more mobile, public good level decreases. The intuition relies on the negative relation between tax rate and capital mobility. As capital mobility increases, governments choose to decrease tax rate. Hence, governments have less tax revenue to spend, which decreases public good level.

When capital mobility increases, governments can spend less for their own self-interested purposes, as in the public good level. Because, governments have less tax revenue to spend. (See Figure 5.3.)

In addition, degree of selfishness does not affect direction or curvature of the relations between capital mobility and above variables (public good level and rent seeking variables).⁴⁰ Redistributive rule parameter, which is punishment parameter (p) for this case, is not affected by the change in capital mobility.

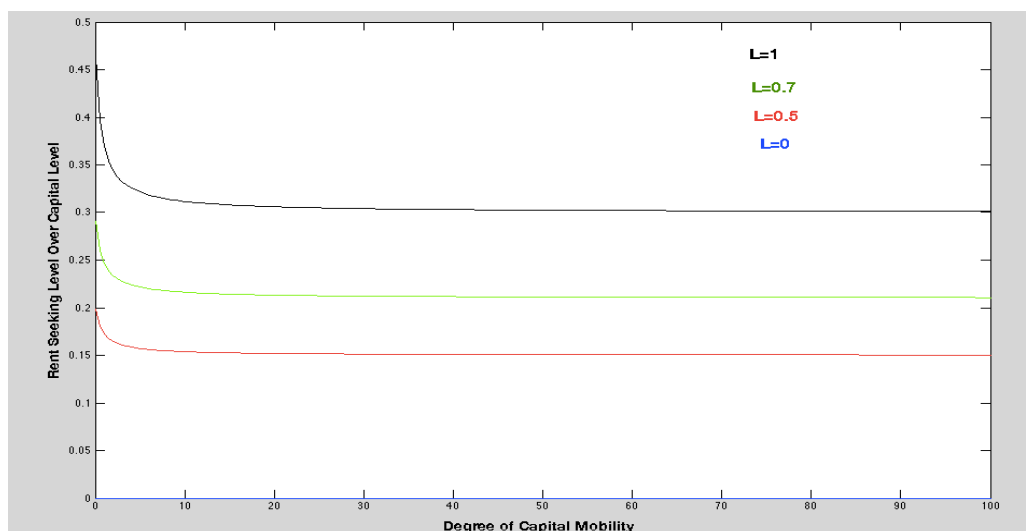


Figure 5.3. Graph of Rent Seeking Variable and Degree of Capital Mobility

⁴⁰ Shifts are observed when selfishness degree changes. The direction of these shifts is explained in detail in the coming part (The effects of Degree of Selfishness)

- **The Effects of Degree of Positive Spillovers**

In the model, degree of positive spillovers, which is represented by s , is introduced in the utility function. It gives degree of how much citizen can take utility from the neighbor's public good level. The maximum level for s is 1, since citizens cannot take more utility from neighbor's public good compared to the home public good level. If $s = 0$, the citizens only care about his home public good level whereas if $s = 1$, citizens take equal utility from the levels of public good at both jurisdictions.

In this case (no equity in redistribution rule), neither tax rate nor level of capital depends on degree of positive spillovers. Also public good level and rent seeking variable are not affected by degree of positive spillovers. Only the utility function is affected by s .⁴¹

- **The Effects of Degree of Selfishness**

The degree of selfishness of the politician is represented by L in the model. This parameter shows how much local government concerns only about his own interests or cares about the citizen's utility. $L = 0$ implies that government is fully benevolent, whereas if $L = 1$, the government is fully selfish.

As can be observed from the first order derivative of tax rate with respect to degree of selfishness and from Figure 5.4, the relationship between tax rate and selfishness parameter is positive. As the politician becomes more and more selfish, local government cares less and less about citizens. This makes local governments to increase tax rate.

Another observation is the effect of capital mobility onto this relationship. As capital mobility increases, the relation between tax rate and selfishness degree weakens. The intuition behind this finding is based on the relationship between tax rate and capital mobility. As capital mobility increases, regardless of the selfishness

⁴¹ See Welfare Comparison (5.2) to see the effect of s onto utility function.

degree, local government has a tendency to decrease tax rate in order not to lose capital. So, dominated effect of the increase of tax rate due to the increase in selfishness degree over decrease of tax rate due to the increase in capital mobility disappears.

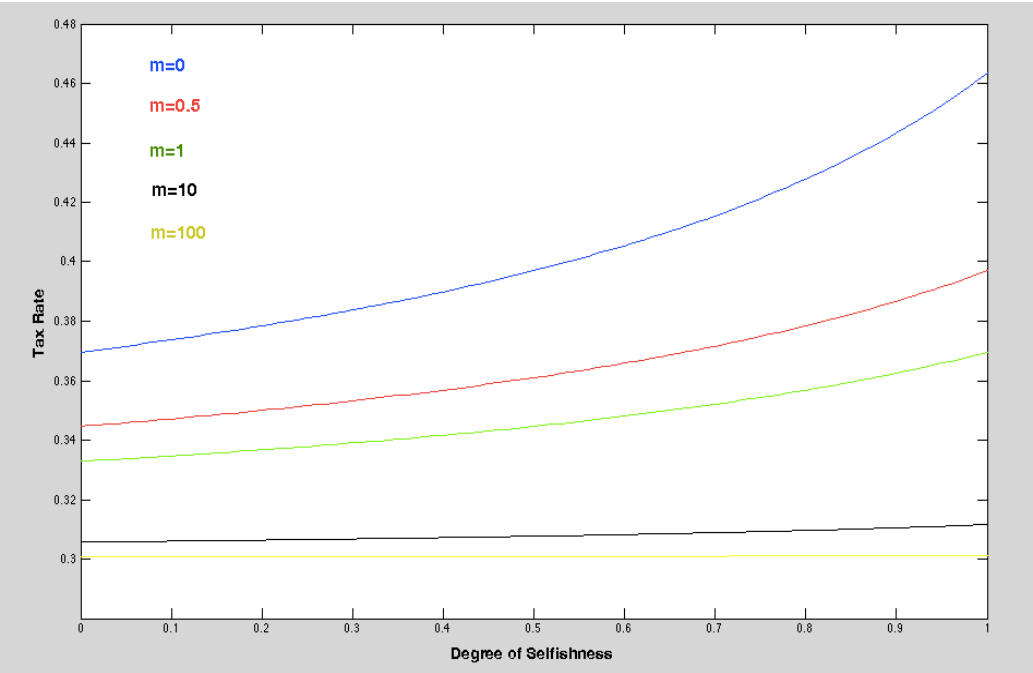


Figure 5.4. Graph of Tax Rate and Degree of Selfishness of the Politician

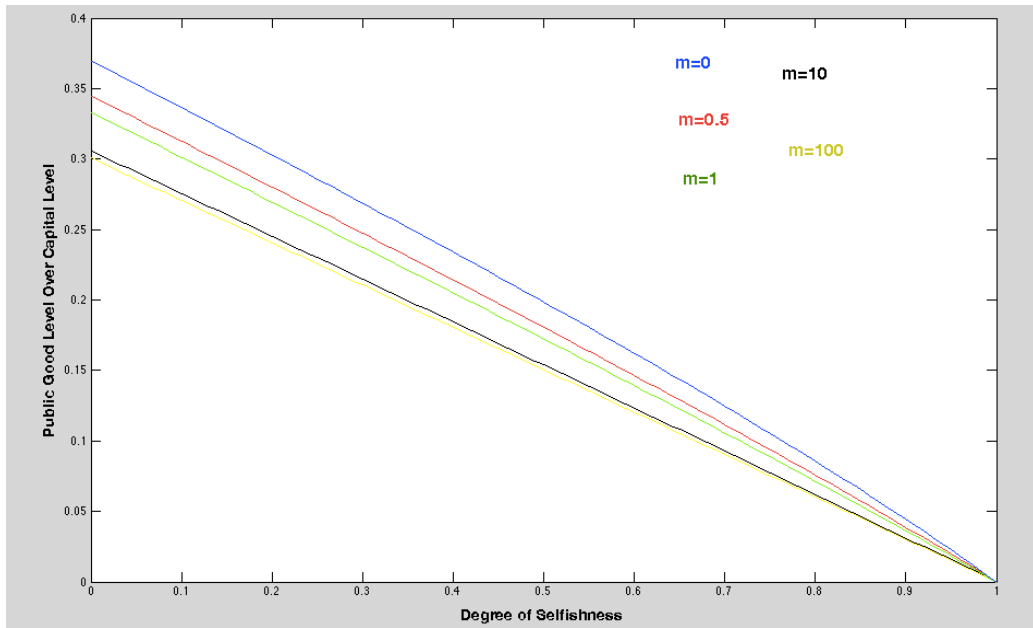


Figure 5.5. Graph of Public Good Level Over Capital Level and Degree of Selfishness of the Politician

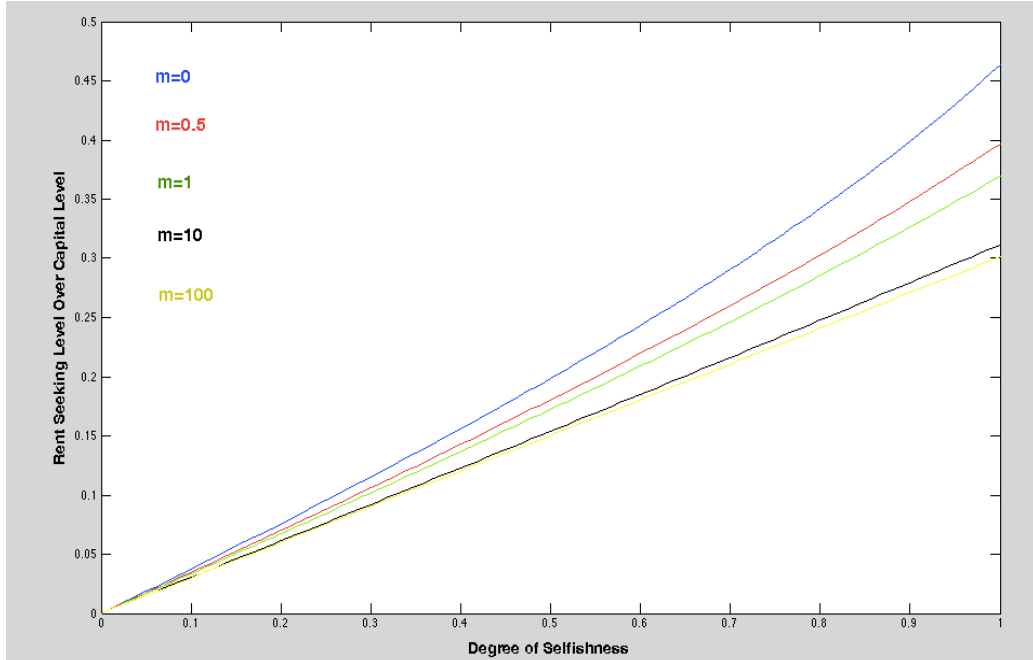


Figure 5.6. Graph of Rent Seeking Variable Over Capital Level and Degree of Selfishness of the Politician

The changes in the degree of selfishness affect the ratio of public good level over capital level negatively. When degree of selfishness is increased; although local government increases tax rate and this leads to higher tax revenue; local government chooses less amount of public good. Since $1 - L$ is smaller now, local governments take less utility by increasing public good level⁴². So they choose to raise rent-seeking level. (See Figure 5.5 and 5.6)

Another observation is that negative relationship between public good level with degree of selfishness becomes flatter and flatter as capital mobility increases as in Figure 5.4. The reason behind this relationship arises from the same reason as above.

- **The Effects of Targeted Variables**

Redistribution mechanism is composed of two properties: equity and efficiency.⁴³ In the redistribution mechanism, tax revenue target and income target levels are set exogenously. Since for this case, only efficiency property exists in the redistribution rule, income target level does not affect any variables.

Setting target for tax revenue provides collected tax levels around this level. In other words, it provides fiscal discipline because as targeted tax rate increases, actual tax rate, decided by the local government, also increases accordingly. (See Figure 5.7) The negative relationship between capital mobility and tax rate can also be observed from Figure 5.7.

⁴² Local Government's utility level $V = (1 - L) \int_0^\infty e^{-\rho t} [\ln C_t + \ln G_t + s \ln G_t^f] + L \int_0^\infty e^{-\rho t} [\ln R_t] dt$

⁴³ The redistribution mechanism is explained in detail in the Model Part, 3.4.

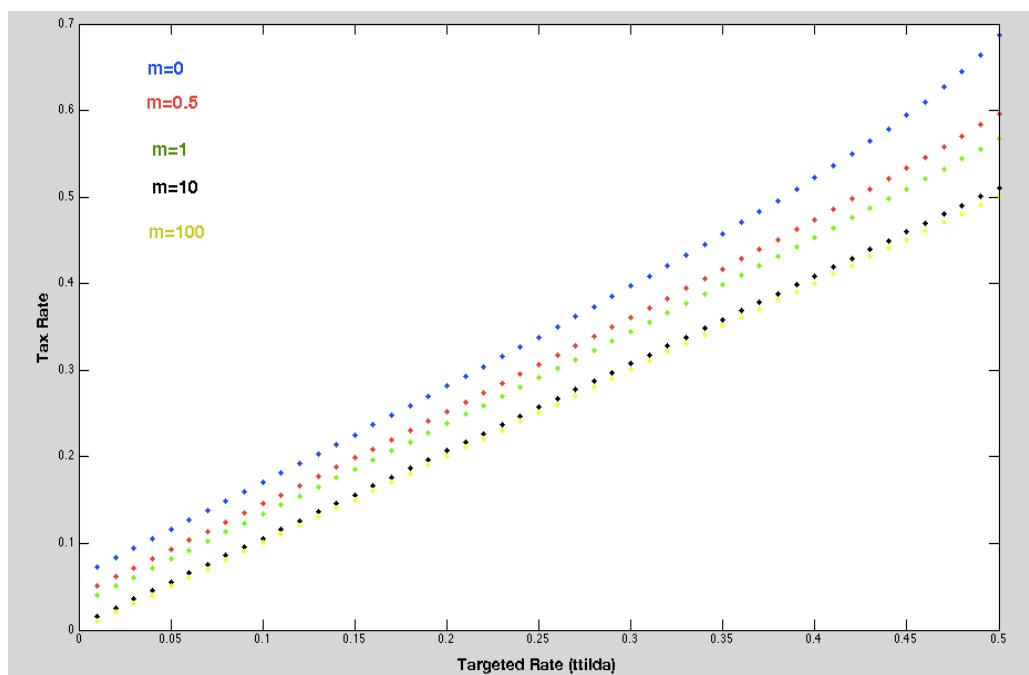


Figure 5.7. Graph of Tax Rate and Targeted Rate (s=0.5)

5.1.2 No Efficiency in Redistribution Rule

Lemma 2: (No Efficiency) The findings for symmetric equilibrium are as follows:

- Optimal tax rate (τ_1) is independent of time.

$$\tau_1 = \frac{1}{A(1+m)}$$

- The public good level is a function of capital and some exogenous parameter values

$$G_{1,t} = \varphi(1-L)(\tilde{y} - A)K_{1,t}$$

- The rent seeking variable is a function of capital and some exogenous parameter values

$$R_{1,t} = \varphi L(\tilde{y} - A) K_{1,t}$$

- Capital and consumption depends on initial capital and some exogenous parameter values

$$\begin{aligned} K_t^1 &= K_0^1 e^{\chi t} \\ C_t &= \rho K_t^1 \end{aligned}$$

where $\chi = A - A\tau_1$

- The redistributive rule parameter (φ) depends on degree of capital mobility (m), targeted income level (\tilde{y}) and technology level (A)

$$\varphi = \frac{1}{A(1+m)(\tilde{y}-A)}$$

Proof: See Section 4.2 for the solution.

As you can see from Lemma 2, optimal tax rate only depends on capital mobility (m) and level of technology (A). However, optimal level of redistributive rule parameter is too complicated to distinguish the effects. For this case, simulation analysis is needed.

- **The Effects of Capital Mobility and Degree of Selfishness**

For this case (no efficiency in the redistribution rule), the relation between tax rate and capital mobility is unambiguous from first order derivative.⁴⁴ Since tax rate only depends on capital mobility and technology level, no other parameter can affect tax rate. When capital mobility increases, renting capital from the neighbor jurisdiction becomes less costly. So in order to cease potential loss in capital, local governments decrease the tax rate.

⁴⁴ First order derivative of tax rate with respect to technology level is $d\tau/dA = -\frac{1}{(A^2(1+m))}$, since $\tau = \frac{1}{A(1+m)}$

Public good level and rent seeking level also have negative relationship with capital mobility. (See Figure 5.9 and 5.10) This implies decreasing tax rate, because of the increase in capital mobility, can not prevent losing capital tax revenue. And since tax revenue is used either for public good provision or for his own self-interested purposes, decrease in tax revenue lessens public good level and rent seeking level.

In addition, as selfishness of the politician increases, the politician takes more utility from rent seeking variable compared to public good provision. This leads to increases in the ratio of rent seeking level over capital level and decreases in the ratio of public good level over capital level. (Figures 5.9 and 5.10)

Tax rate levied on capital cannot exceed ratio 'one' because capital income can not be taxed more than itself. Hence tax rate should be between 'zero' and 'one'. As you can see from Figure 5.8, for low levels of capital mobility⁴⁵, tax rate is above its maximum level. This implies under low levels of capital mobility, introducing only equity property to the redistribution mechanism may cause serious problems in choosing optimal tax rate.

⁴⁵ To be more specific, when capital mobility is above 'two', tax rate exceeds 'one', i.e. when $m > 2$ then $\tau > 1$

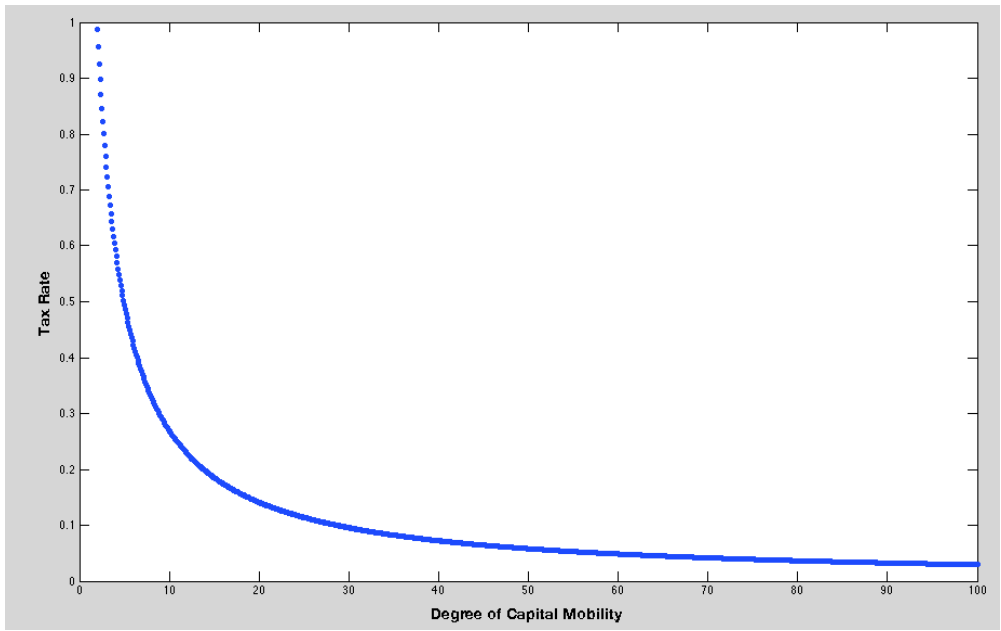


Figure 5.8. Graph of Tax Rate and Degree of Capital Mobility

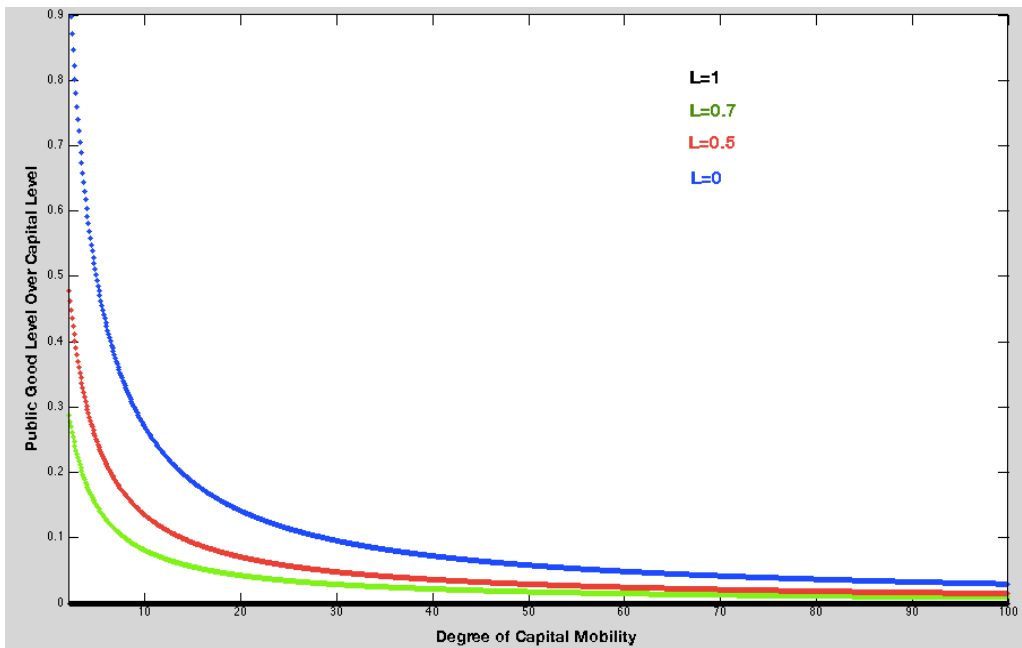


Figure 5.9. Graph of Public Good Level Over Capital and Degree of Capital Mobility

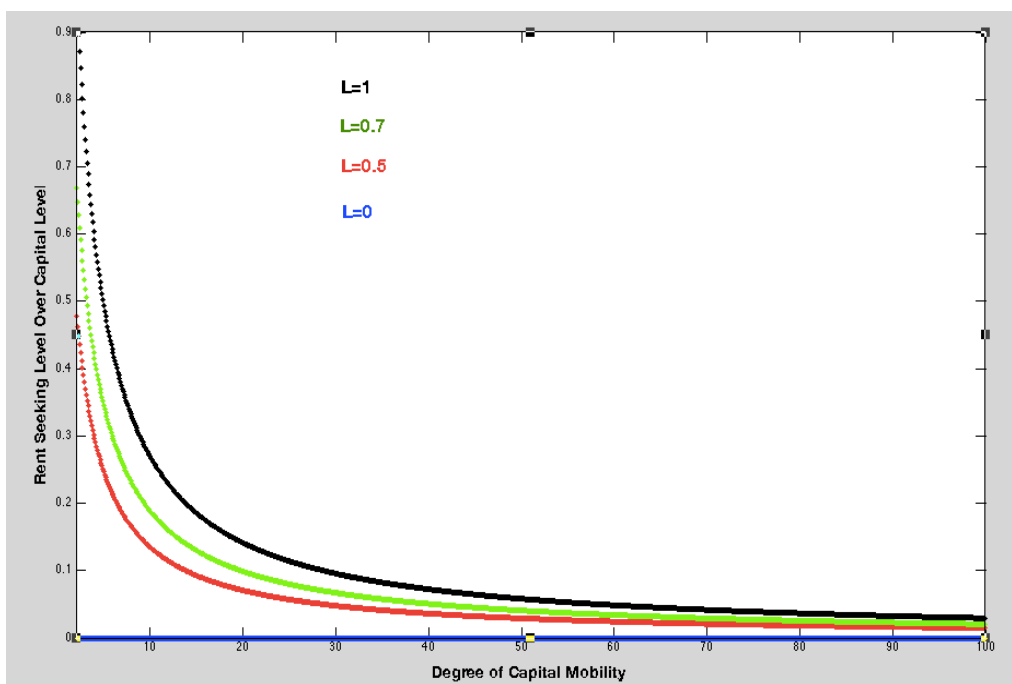


Figure 5.10. Graph of Rent Seeking Level Over Capital and Degree of Capital Mobility

5.1.3 Full Redistribution Rule

Lemma 3: (Full Redistribution Rule) The findings for symmetric equilibrium are as follows:

- Optimal tax rate (τ_1) is independent of time.
- The public good level is a function of capital, tax rate and other exogenous parameter values

$$G_{1,t} = \frac{p\rho(1-L)}{A(2-L)[1+(1+m)(A-A\tau_1)]} K_{1,t}$$

- The rent seeking variable is a function of capital, tax rate and other exogenous parameters

$$R_{1,t} = \frac{p\rho L}{A(2-L)[1+(1+m)(A-A\tau_1)]} K_{1,t}$$

- Capital and consumption depends on initial capital and other exogenous parameters

$$K_t^1 = K_0^1 e^{\chi t}$$

$$C_t = \rho K_t^1$$

where $\chi = A - A\tau_1$

- The redistributive rule parameters (p and φ) depend on some exogenous parameter values.

Proof: See Section 4.3 for the solution.

As you can see from Lemma 3, optimal tax rate depends only on some exogenous parameters, but because of the complexity of optimal tax rate with redistributive rule parameters, it is hard to see the relationships. Simulation analysis gives these necessary relations.

- **The Effects of Capital Mobility and Degree of Selfishness**

As stated before, redistribution mechanism has two properties: equity and efficiency. In previous two sections, these properties are included one by one, but in this section, both properties are comprised. Since the analytic solutions of the choice variables are too long and complicated, unambiguous solutions are not observed.

There is a negative relationship between tax rate and degree of capital mobility as in the previous cases. (Figure 5.11) Increase in capital mobility induces less cost in capital movements, so losing capital becomes easier. In order not to lose capital, local governments decrease the tax rates.

Another observation is the positive relation between tax rate and degree of selfishness. When politician becomes more selfish, local governments choose higher tax rates in order to increase their rent-seeking share from tax revenue. However, the difference between these chosen tax rates diminishes as capital mobility increases, due to the inverse relation between tax rate and capital mobility. (Figure 5.11)

When politician is fully selfish ($L = 1$), local governments use all resources for his own self-interested purposes, i.e. no public good provision. On the other hand, fully benevolent government ($L = 0$) takes into account only utility of citizens, i.e. no rent seeking share. Hence, as shown in Figures 5.12 and 5.13, the higher the degree of selfishness, the higher the rent seeking and the lower the public good level are.

Adverse relation of capital mobility with tax rates reflects the similar relation with public good and rent seeking levels. In other words, since less tax revenue occurs when tax rate decreases if capital mobility increases, and tax revenue is shared among public goods and politician's self interested expenses, public good level and rent seeking level also decrease as capital mobility increases. (Figures 5.12 and 5.13)

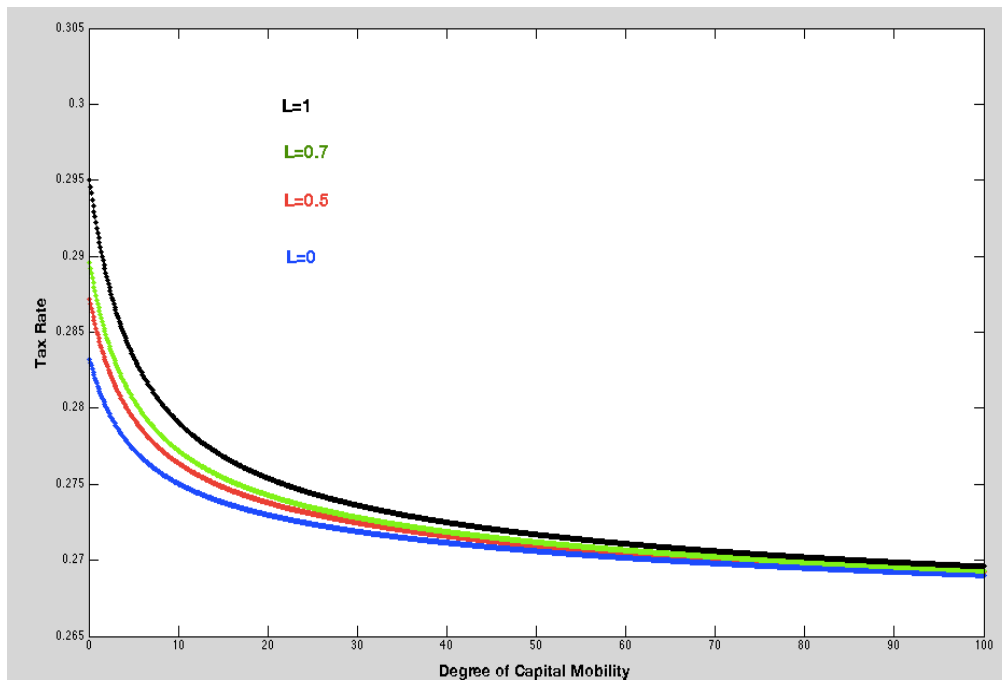


Figure 5.11. Graph of Tax Rate and Degree of Capital Mobility

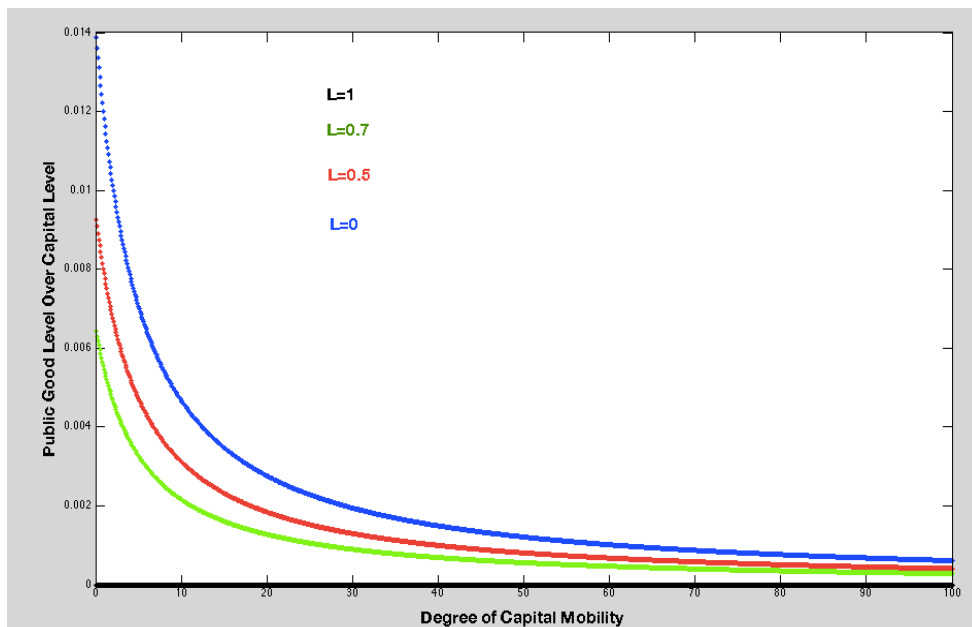


Figure 5.12. Graph of Public Good Level Over Capital and Degree of Capital Mobility

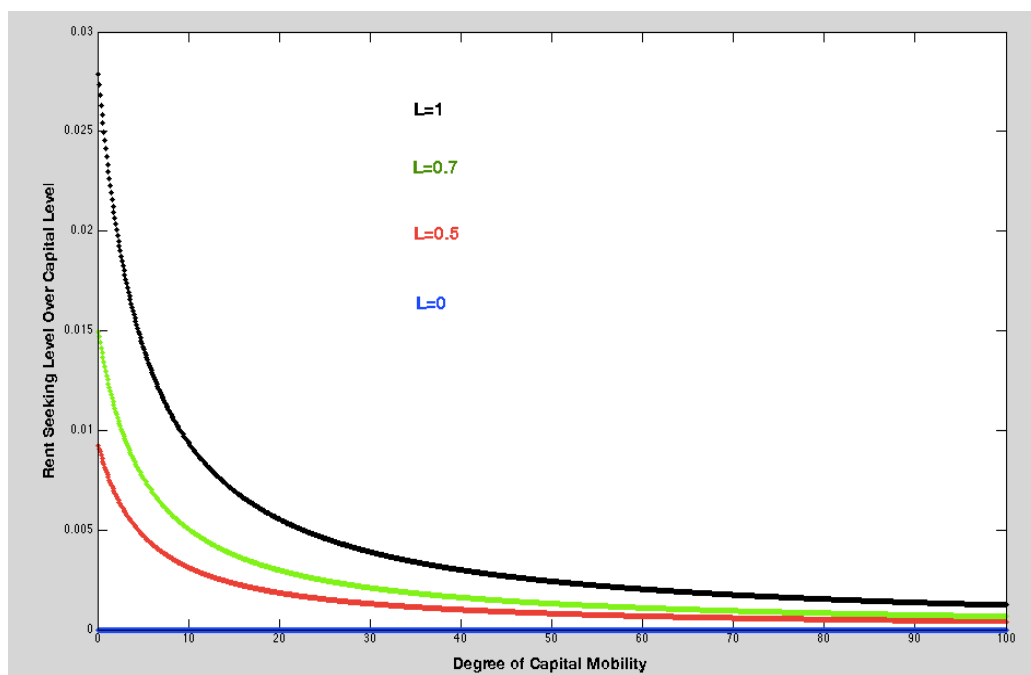


Figure 5.13. Graph of Rent Seeking Level Over Capital and Degree of Capital Mobility

5.1.4 No Redistribution Rule

Lemma 4: (No Redistribution Rule) The findings for symmetric equilibrium are as follows:

- Optimal tax rate (τ_1) is independent of time.

$$\tau_1 = \frac{\left(L - 2A - 2Am + \left((L - 2) \left(\begin{array}{l} L - 4A - 4\rho - 4Am + 4m\rho \\ + A^2L - 4A^2m - 2A^2 \\ - 2A^2m^2 + 2AL + A^2Lm^2 \\ + 2ALm + 2A^2Lm - 2 \end{array} \right) \right)^{1/2} \right)}{2A(L - 2)(1 + m)}$$

- The public good level is a function of capital, tax rate and other exogenous parameter values

$$G_{1,t} = \frac{p\rho(1-L)}{A(2-L)[1+(1+m)(A-A\tau_1)]} K_{1,t}$$

- The rent seeking variable is a function of capital, tax rate and other exogenous parameters

$$R_{1,t} = \frac{p\rho L}{A(2-L)[1+(1+m)(A-A\tau_1)]} K_{1,t}$$

- Capital and consumption depends on initial capital and other exogenous parameters

$$\begin{aligned} K_t^1 &= K_0^1 e^{\gamma t} \\ C_t &= \rho K_t^1 \end{aligned}$$

where $\chi = A - A\tau_1$

Proof: See Section 4.4 for the solution.

Solutions of the model reveal that the tax rate is time independent for all of the cases, but it is too complicated to make interpretations about the effects of exogenous variables. To interpret the effects and compare the results, simulation analysis is necessary.

- **The Effects of Capital Mobility and Degree of Selfishness**

The relation between tax rate and capital mobility is similar with the previous cases. In other words, as capital mobility increases, tax rate decreases in order not to lose capital to other jurisdiction. The highlighting observation from Figure 5.14 that tax rate levels is so much lower than the previous cases which includes efficiency property. This induces the fact that setting a target for tax revenue controls tax rate, but without a target level, local governments have limited effect onto tax rates.

Selfishness of the politician has also the same effect onto tax rate, public good level over capital and rent seeking level over capital. Similar observation occurs in

Figures 5.15 and 5.16, that these ratios are lower than the previous cases. Due to low levels of tax rate and tax revenue, public good and rent seeking levels are less.

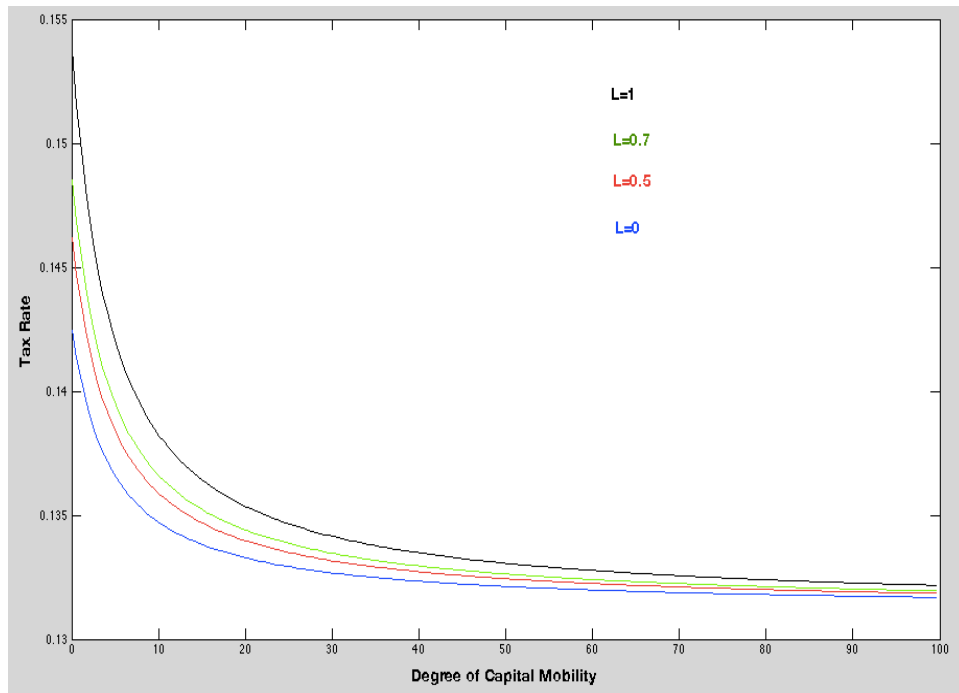


Figure 5.14. Graph of Tax Rate and Degree of Capital Mobility

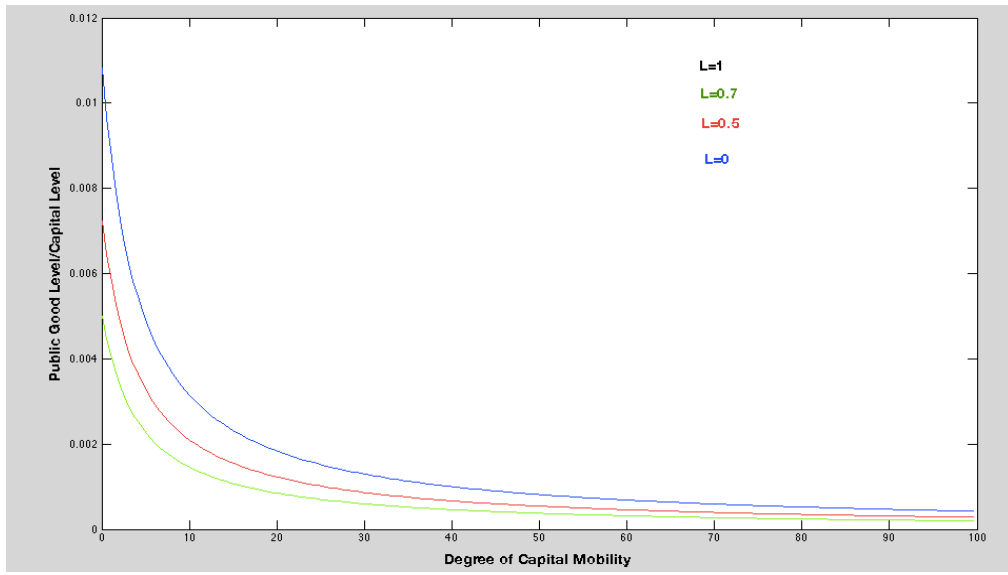


Figure 5.15 Graph of Public Good Level Over Capital and Degree of Capital Mobility

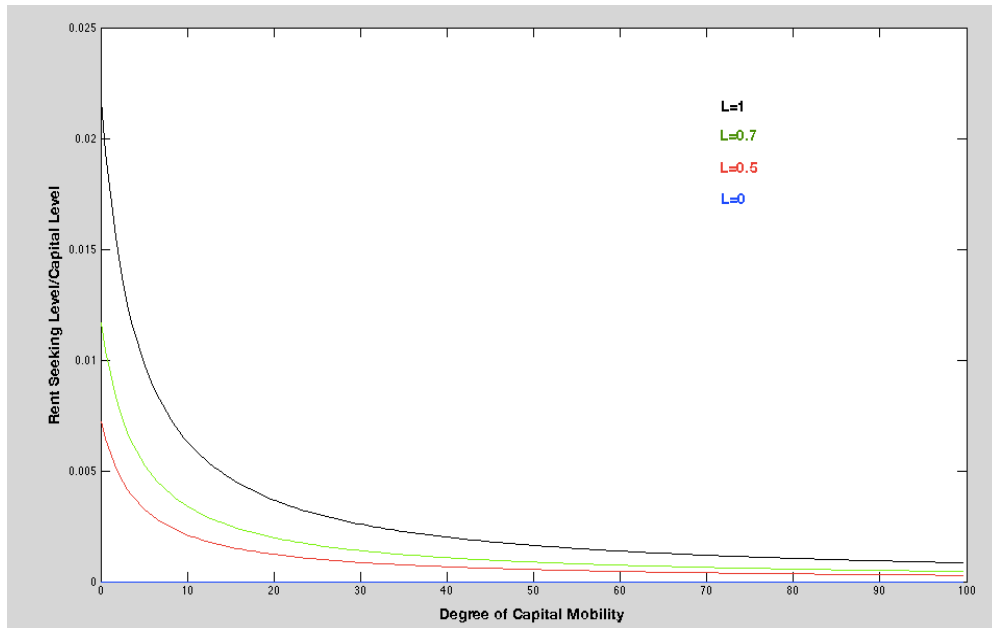


Figure 5.16 Graph of Rent Seeking Level Over Capital and Degree of Capital Mobility

5.2. Welfare Comparison

5.2.1. No Equity Versus No Efficiency in a Redistribution Rule

Welfare is defined as the present discounted lifetime utility of a citizen. The total utility of a citizen is composed of utility of private consumption level, public good level at home jurisdiction and public good level at foreign jurisdiction⁴⁶ through time.

Figure 5.17 shows welfare levels for the first two cases: no efficiency property and no equity property in the redistribution rule. Each parallel line with the same color represents different degrees of positive spillovers for the belonging case. Higher degree of positive spillovers induces higher welfare levels.

The comparison between welfare levels for these cases depends on the degree of capital mobility. For low levels of capital mobility, i.e. if capital is not mobile enough, no equity case gives higher welfare levels than no efficiency case.⁴⁷ (Figure 5.17) The reason behind changing this behavior with degree of capital mobility is the higher impact of capital mobility on tax rate in equity case (no efficiency property in redistribution rule) than efficiency case. (no equity property in redistribution rule).⁴⁸

In efficiency case (no equity in the redistribution rule), targeted tax revenue is set exogenously. Local governments choose tax rate around this level in order not to lose transfer payments given by the central government. Due to this fact that welfare level does not change as rapidly as in the other case (no efficiency property in redistribution rule) In other words, since there is no target for tax revenue level in

⁴⁶ Detailed information about citizen's utility function can be found in Section 3.1.

⁴⁷ To be more specific, there is threshold level '8.3' in which above that level $U_{p=0} > U_{\varphi=0}$ and below that level $U_{p=0} < U_{\varphi=0}$.

⁴⁸ There is no such a comparison in the literature, since most of the studies about intergovernmental transfers focus on either explaining the existing rules or suggesting some properties for well designed intergovernmental transfers.

equity case (no efficiency property in redistribution rule), tax rate moves in a higher range, which causes welfare levels to change rapidly (Figure 5.18),

This comparison states that under low levels of capital mobility, central government should give more weight to efficiency property compared to equity property.

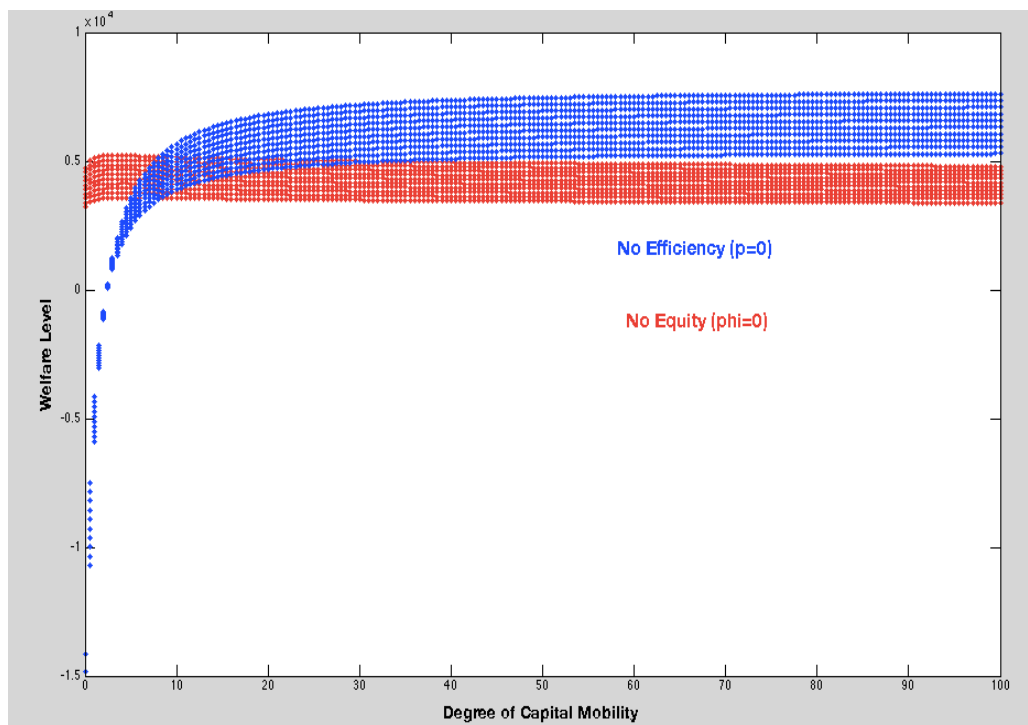


Figure 5.17. Graph of Welfare Level and Degree of Capital Mobility

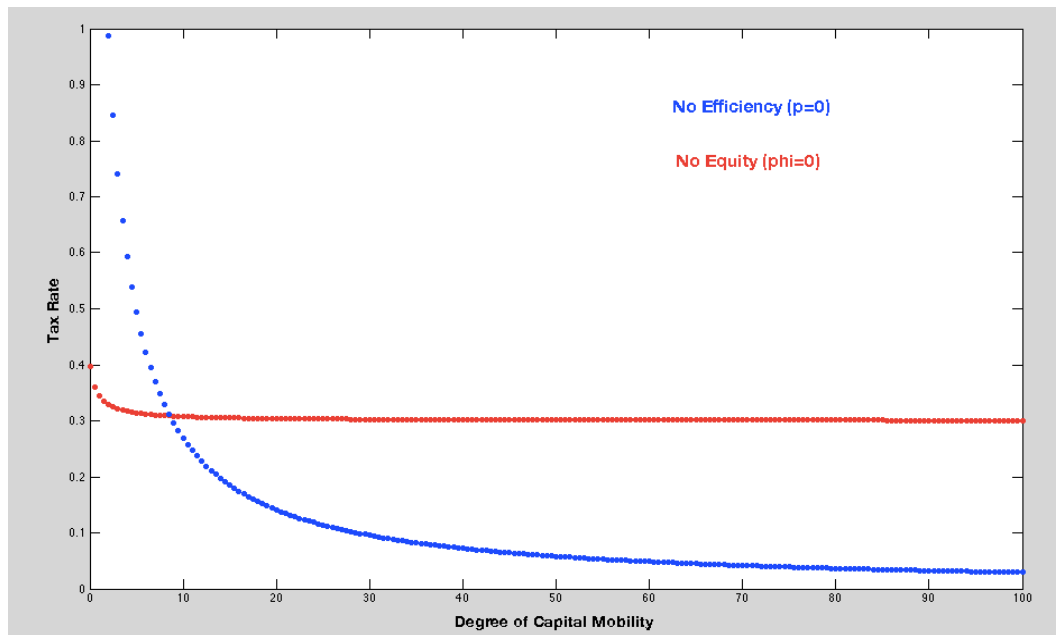


Figure 5.18. Graph of Tax Rate and Degree of Capital Mobility

5.2.2. Full Redistribution Rule Versus No Redistribution Rule

In this study redistribution mechanism has two important features: equity and efficiency. In the previous section, these two features are compared according to citizen's welfare levels. In this section, the welfare levels, in which central government uses redistribution rule with all properties, are compared with the ones, in which no redistribution rule is implemented.

Each parallel line with the same color in Figure 5.19 shows the welfare levels for different degrees of positive spillovers. As degree of positive spillovers increases, the welfare of a citizen increases. 'Red' lines represent the welfare levels for full redistribution rule case, whereas 'Blue' lines show the welfare levels for no redistribution rule case.

The welfare comparison does not change with any of the exogenously set parameters, different from the previous finding. The welfare in full redistribution case is always higher than the one in no redistribution rule case. (Figure 5.19) It shows usefulness of the redistribution mechanism by not only providing fiscal discipline but also increasing the welfare.

In full redistribution rule case, a target for tax revenue is set exogenously by efficiency property, however in no redistribution rule case, localities are free to choose any tax rate since they are not tied with any target. Hence, in full redistribution rule, tax rates are higher than the no redistribution rule (Figure 5.20). At first glance, low levels of tax rate means an improvement for citizens due to the higher level of disposable income, but it also implies low levels of tax revenue, and hence low levels of public good provision. In the model part, objective function of a citizen is not only composed of consumption level but also public good level at home jurisdiction and neighbor jurisdiction. Consumption level may increase, because of the increase in disposable income, but public good provision levels lessen which causes lower levels of utility. In other words, the increase in consumption level is dominated by the decrease in public good level at home and neighbor jurisdictions.

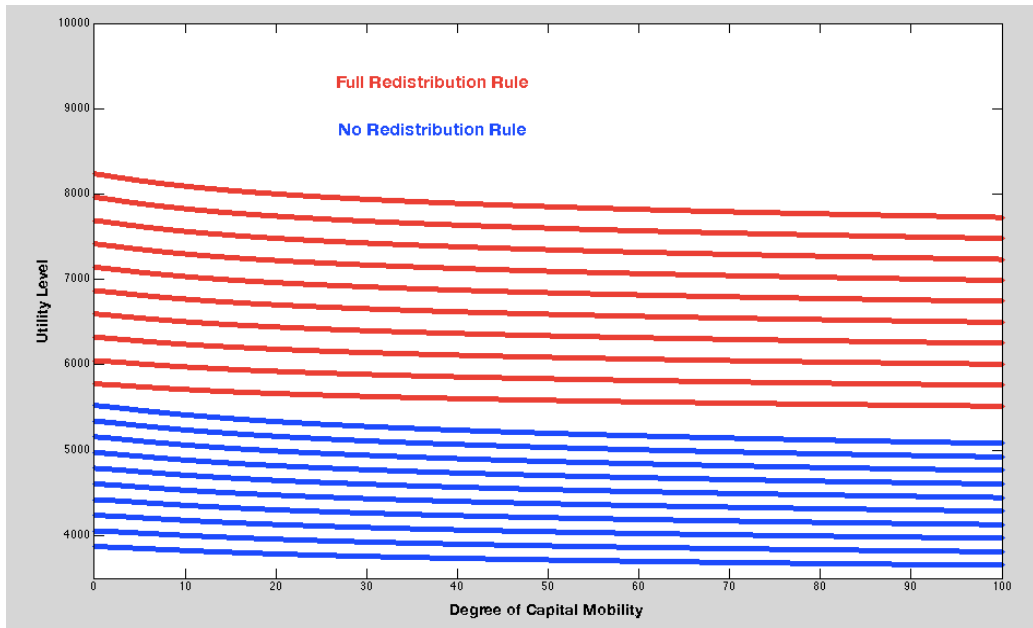


Figure 5.19. Graph of Welfare Level and Degree of Capital Mobility

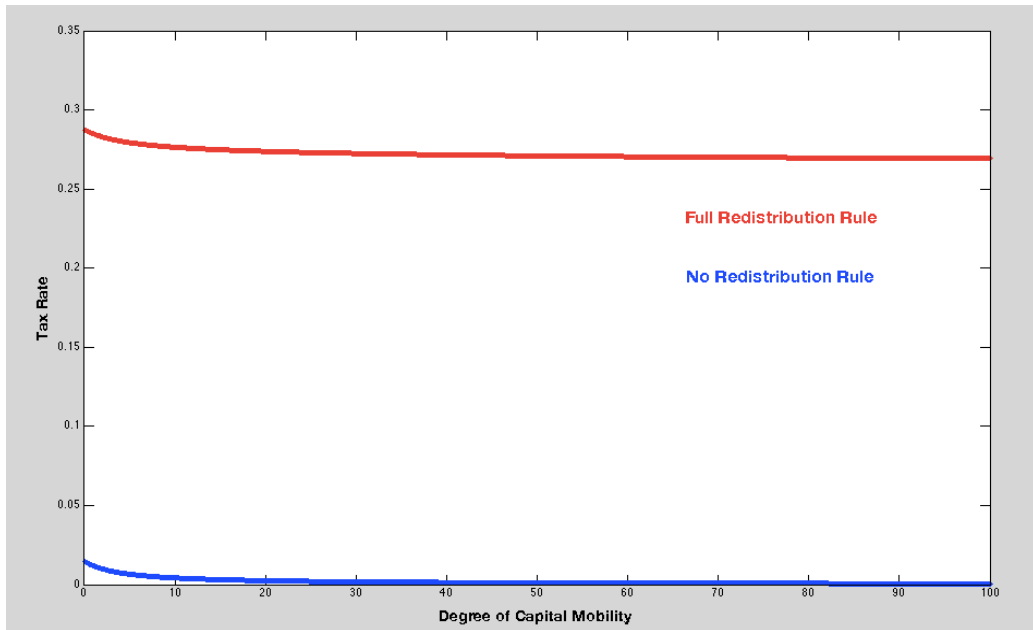


Figure 5.20. Graph of Tax Rate and Degree of Capital Mobility

CHAPTER 6

CONCLUSION

There is an extensive literature about how the structure of intergovernmental transfers is in developed and developing countries. Since each country has its own specific features, the properties of each intergovernmental transfer are designed and implemented in a unique way. However, the objectives of most of the governments are more or less the same; alleviate fiscal imbalances, correct for inter-jurisdictional externalities and amend administrative weaknesses. With these in mind, Akin et. al. (2016) constructed a redistribution mechanism that has equity and efficiency properties to represent the objectives of the governments in a simple way. This study is investigating the welfare effects of these properties in a fiscally decentralized set-up. The model includes interaction between citizens, local governments and central government, which is a significant contribution.

The model is an A-K type endogenous growth model with continuous time. There is tax competition between localities through mobile capital. In addition, public good spillovers are formed which cannot be internalized among jurisdictions.

Local governments are free to design fiscal policy by determining tax rate and public good levels. Capital is mobile and tax competition exists with public good spillovers. Local governments are not fully benevolent but at some degree, they have a share of tax revenue that can be used for the politicians' self-interested purposes in their objective function. The timing of events starts with the announcement of redistribution rule implementation by central government. Given redistribution rule parameters, local governments maximize their objective function and then citizens solve their own problem. In the literature, interaction between

central government and local government is omitted. This study is trying to fill this gap. This Stackelberg structure of the model provides time consistent policies.

Central government's only aim is to satisfy a linear redistribution rule. This rule is taken from Akin et. al. (2016) with slight changes. It has equity and efficiency properties with linearity assumption. Linearity assumption provides agents of the economy to understand the rule easily and make long-term plans. With efficiency property, tax collection effort is aimed to be maximized and revenue is to be sufficient enough to fulfill citizens' needs. Equity property is introduced to decrease horizontal fiscal imbalances.

The model differentiates according to properties in the redistribution rule. In the first case (no equity), redistribution rule has only efficiency property. This property aims to discipline local governments by setting a tax revenue target and changing the transfer amount accordingly. In the second case (no efficiency), redistribution rule has only equity property. The purpose is to compensate income across localities through income target. The welfare comparison between these two cases depends on the degree of capital mobility. For low levels of capital mobility, no equity case has higher welfare level than no efficiency case. On the other hand for high levels of capital mobility, no efficiency case provides higher welfare. This result tells that in case of high mobility, government should give more weight to equity case in redistribution rule, because high mobility already induces some fiscal discipline to local governments.

Only revenue for governments comes with capital income taxation, hence a change in degree of capital mobility directly affects tax rate. When capital gets more and more mobile, capital can move less and less costly. So, it becomes easier to lose capital. Hence in order not to lose more capital, governments decrease their tax rate when capital mobility increases in all cases. In no equity case, as selfishness of the politician increases, tax rate also increases. When politician becomes more selfish, local governments choose higher tax rates in order to increase their rent-seeking share from tax revenue. However, the difference between these chosen tax rates

diminish as capital mobility increases, due to the inverse relation between tax rate and capital mobility in no equity case.

Another observation is that as selfishness of the politician increases, tax rate does not change in no efficiency case. This non-dependence implies that central government should give more weight to equity property in the redistribution mechanism when the politicians' selfishness degree is too high. The degree of positive spillovers do not affect any policy variable, it only affects the welfare levels positively. In other words, as the degree of positive spillovers increase, welfare level also increases.

Another welfare comparison is among full redistribution rule case and no redistribution rule case. The welfare in full redistribution case is always higher than the one in no redistribution rule case. It shows usefulness of the redistribution mechanism by not only providing fiscal discipline but also increasing the welfare. This finding is consistent with Sanguinetti and Tomassi (2004) and Wildasin (1984). In full redistribution rule case, a target for tax revenue is set exogenously by efficiency property, however in no redistribution rule case, localities are free to choose any tax rate since they are not tied with any target. Hence, in full redistribution rule, tax rates are higher than the no redistribution rule. At first glance, low levels of tax rate means an improvement for citizens due to the higher level of disposable income, but it also implies low levels of tax revenue, and hence low levels of public good provision. In the model part, objective function of a citizen is not only composed of consumption level but also public good level at home jurisdiction and neighbor jurisdiction. Consumption level may increase, because of the increase in disposable income, but public good provision levels lessen which causes lower levels of utility. In other words, the increase in consumption level is dominated by the decrease in public good level at home and neighbor jurisdictions. During these comparisons and findings, simulation analysis is run, since the equations are too complex to interpret.

In order to reduce the complexity of the model without losing the focus of the study, some limitations are made. For instance, symmetry of jurisdictions. Relaxing this assumption, i.e. asymmetry between localities, may be exhibited in different ways. One of them is difference in income levels. Introducing poor and rich locality to the model provides us to interpret how transfer mechanism affects the course of events. Transfer rule properties may affect poor and rich localities differently. For example, equity property may probably harm the rich locality because as rich stays rich, reduction in transfer amounts continues. Or, the asymmetry may be imposed to localities as different populations. Wilson (1991) shows that residents of a small region are better off than the residents of a large region in terms of low tax rates in small region in a static model. In our model, every variable is in per capita terms, by differentiating populations between localities with different targeted levels in redistribution rule will answer how these different populations affect the policy variables and transfer mechanism. However, solving under symmetric jurisdiction assumption eases the model extremely, introducing different income levels for localities might make the model unsolvable. In the literature, studies about asymmetric jurisdictions are generally argued in static models (Sinn, 1992; Edwards and Keen, 1996; Sato, 2003; Besley and Coate, 2003) in order to make the models solvable and at the same time to answer the questions about asymmetric jurisdictions.

All tax revenue is collected by local governments and fully transmitted to the central government. As an extension, this common pool can be endogenous, in other words, not all tax revenue but a portion of tax revenue can be given to central government to maintain stability in the economy and that portion can be decided endogenously by central government according to the economy's structure. This extension gives more freedom to localities in spending, which is known as revenue decentralization.

In this study, individuals are not allowed to move; only capital can move. However, in some fiscal competition models, depending on tax rate and public good level,

individuals are allowed to move. For example, Tiebout (1956) describes ‘foot voting’ as the ability of households to change their living location at no cost when households are not satisfied from tax rate or goods and services provided by local government. Also households may prefer to live in another location because of better job opportunities. This type of mobility may result with efficient allocation of resources. Hence, labor mobility can be included in the model with the inclusion of labor.

Another assumption, only capital income is taxed to finance local public goods. However, tax types available to local governments can be expanded to include a tax on wage income. Zodrow and Mieszkowski (1986) was criticized by Gordon (1986) for the same reasons, but Wilson (1986, 1999) and Wilson and Wildasin (2004) still prefer to use this type of taxation in their tax competition models due to the same reason, complexity.

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APPENDIX A

LEVEL OF CAPITAL

Since capital is mobile, citizens rent capital not only from home jurisdiction but also from foreign jurisdiction. For simplicity, there are only two jurisdictions; home jurisdiction is locality '1', whereas neighbor jurisdiction is locality '2'.

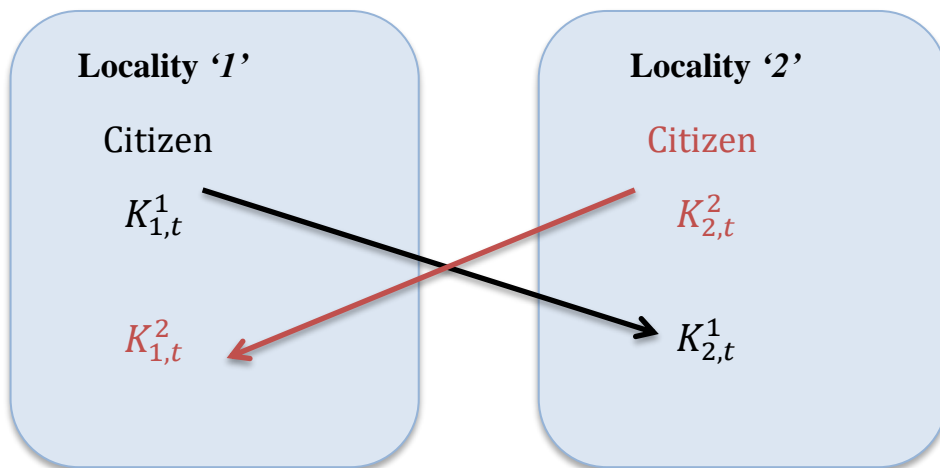


Figure A.1. Level of Capital

The subscript 't' is used as time. Superscript '1' represents the citizen living in locality '1' and since citizens are representative agents, it can be said: superscript '1' shows the citizen '1'. However subscript '1' is directly used for locality '1'.

Citizens are representative agents, in other words, all citizens, who live in that locality, are identical. Level of capital, taxed by local government '1', is as follows:

$$K_{1,t} \equiv K_{1,t}^1 + K_{1,t}^2 = (1 - \theta_t^1)K_t^1 + \theta_t^2 K_t^2$$

Level of capital, taxed by local government '2', is as follows:

$$K_{2,t} \equiv K_{2,t}^1 + K_{2,t}^2 = (1 - \theta_t^2)K_t^2 + \theta_t^1 K_t^1$$

Taxation is source-based capital, so tax is levied where it is rented. $\tau_{1,t}$ is tax rate levied at home jurisdiction, locality '1' and $\tau_{2,t}$ is tax rate levied at neighbor jurisdiction, locality '2' So, tax revenue for locality '1' is as follows:

$$\tau_{1,t}K_{1,t} = \tau_{1,t}K_{1,t}^1 + \tau_{1,t}K_{1,t}^2 = \tau_{1,t}(1 - \theta_t^1)K_t^1 + \tau_{1,t}\theta_t^2 K_t^2$$

Tax revenue for locality '2' is as follows:

$$\tau_{2,t}K_{2,t} = \tau_{2,t}K_{2,t}^1 + \tau_{2,t}K_{2,t}^2 = \tau_{2,t}(1 - \theta_t^2)K_t^2 + \tau_{2,t}\theta_t^1 K_t^1$$

Also, citizens, who live in locality '1', rent capital from locality '1' and from locality '2' since capital is mobile. It can be written as follows:

$$K_t^1 = K_{1,t}^1 + K_{2,t}^1$$

Also, citizens, who live in locality '2', rent capital from locality '1' and from locality '2' since capital is mobile. It can be written as follows:

$$K_t^2 = K_{1,t}^2 + K_{2,t}^2$$

Jurisdictions are assumed to be symmetric which implies $\tau_1 = \tau_2$ and $K_t^1 = K_t^2$ as shown in Solution part⁴⁹. This assumption simplifies above equations as follows:

$$K_{1,t}^1 = K_{2,t}^2$$

$$K_{2,t}^1 = K_{1,t}^2$$

$$\tau_{1,t}K_{1,t} = \tau_{1,t}(1 - \theta_t^1)K_t^1 + \tau_{1,t}\theta_t^2 K_t^2 = \tau_{1,t}K_t^1$$

$$\tau_{2,t}K_{2,t} = \tau_{2,t}(1 - \theta_t^2)K_t^2 + \tau_{2,t}\theta_t^1 K_t^1 = \tau_{2,t}K_t^2$$

⁴⁹ See Chapter 4 for detailed explanation.

APPENDIX B

TURKISH SUMMARY

Yönetimler arası transferler, eyalet ve yerel hükümetler için önemli bir gelir kaynağıdır. Bu transferler dikey ve yatay mali dengesizliklerden dolayı ortaya çıkmıştır. Mali dengesizlikler basitçe hükümet harcamamaları ile gelirleri arasında görülen farklılıklardan kaynaklanmaktadır. Eğer gelir ve giderlerdeki bu uyumsuzluk farklı seviyede iki hükümet (yerel ve merkezi hükümet gibi) arasında görülürse, buna dikey mali dengesizlik denir. Eğer bu uyumsuzluk aynı seviyede hükümet arasında görülürse, buna yatay mali dengesizlik denir. Bu tip uyumsuzlukları ortadan kaldırmak için, çoğu ülke, Avustralya, Amerika Birleşik Devletleri, Birleşik Krallık gibi, yönetimler arası transferleri kullanmaktadır. Gamkhar ve Shah (2007), yönetimler arası transferler genellikle farklı amaçlar için kullanıldığını belirtmiştir. Bu amaçlardan bazılarının şu şekilde sıralayabiliriz: dikey mali boşluklarla mücadele etmek, yatay mali eşitsizlikleri ortaya koymak, ulus-altı yönetimi vergilendirme, harcama ve yerel ekonomik stabilizasyon gibi politikalarını etkilemek.

Gelir ve gider arasındaki dengenin sağlanmasına duyulan ihtiyaca rağmen, yönetimler arası transferlerin, yerel hükümetlerin yarattığı ahlaki tehlike (moral hazard) probleminden dolayı, mali disiplin üzerine negatif etkileri görülebilmektedir. Merkezi hükümet tarafından dağıtılan transferler, yerel hükümetler arasındaki eşitliği sağlama amacından dolayı, yerel hükümetler için negatif şoklara karşı bir sigorta mekanizması gibi düşünülmektedir. Bu sigorta görüşü, yerel hükümetlerin aldığı zayıf kararların sonucundan korunma sağlayacağı düşüncesinden dolayı potansiyel risklerden koruyacak politika hareketlerini almaktan çekinmelerini sağlamasına neden olmaktadır. Bu duruma ahlaki tehlike denmektedir. Bu sebeplerden dolayı, efektif transfer

mekanizması bazı özelliklere sahip olmalıdır: gelir yeterliliği, yerel vergi toplama çabası, eşitlik, şeffaflık ve istikrar (Ma, 1997; Shah, 1995). Yerel hükümetler, vatandaşların ihtiyaçlarını karşılaması için belirli seviyede gelir kaynağına ihtiyaç duymaktadır, bu sebepten dolayı gelir yeterliliği kriteri iyi tasarlanmış transfer mekanizması özellikleri arasında olmalıdır. Yerel vergi toplama çabası ve harcama kontrolü kriteri, mali disiplini sağlamayı amaçlar. Söz konusu mali disiplin, maksimum seviyede vergi çabası sağlama ve sürdürülemeyen mali açıkları engelleme yoluyla sağlanır. Şeffaflık ve istikrar kriteri ise, gelecek dönemler için bütçe hazırlanırken gelirlerin doğru tahmin edilmesini sağlayacağından dolayı transfer mekanizması özellikleri arasında olmalıdır. Ma (1997), yeniden dağıtım kuralının uzun dönem yerel planların düzgün yapılması gerekliliğinden dolayı çok sık değişmemesi gerektiğini düşünmektedir. Ma (1997)'ya göre, son özellik eşitlik kriteridir. Bu kriterler, yerel hükümetlerin mali gerekliliklerine uygun bir şekilde transfer miktarlarının değişmesi gerektirir.

Transferlerin dağıtımında mali disiplin diğer bir sorun olarak görülmektedir. Yerel hükümetlerin transferlere olan bağımlılığı mali disiplini bozucu şekilde etki edebilir. Eyraud ve Lusinyan (2011) transferlerin mali disipline karşı zararlı etkilerini şu şekilde sıralamaktadır: ortak havuz etkisi, esnek bütçe kısıtı, esnek finansman, yönetim ve hesap verebilirlik, hibe tasarımı ve dikey yayılma. Mesela, ortak havuz etkisi, maliyetlerin içselleştirilmesinden dolayı, ulus-altı hükümetlerin az vergi toplama çabalarına rağmen gereğinden fazla harcama yapması olarak tanımlanmaktadır. Bu olumsuz etkilerin yanısıra, eğer merkezi hükümetler spesifik amaç belirlemediyse veya herhangi bir hedef koymadıysa, yerel hükümetler fonları vatandaşların ihtiyaçlarına uygun bir şekilde harcamayabilirler. Mesela, bir ilçede yerel ulaşım sorunlarını giderebilmek için yeni yol yapımı ve gelişimi yerine, yerel hükümetin güzellik kaygılarından dolayı, yeni çeşme ve parkların yapılması gereksiz harcamaya örnek olarak gösterilebilir. Bu tip gereksiz harcamaları engellemek için, bazı merkezi hükümetler koşullu hibe yöntemini kullanmaktadır. Koşullu hibe, spesifik amaçlar

altında dağıtılırken, koşulsuz hibeler dağıtılırken hiçbir kısıtlama görülmez. Koşulsuz hibelerin amacı, farklı yerel hükümetlerin mali kapasitelerini aynı seviyeye getirerek eşitlemektir. Merkezi hükümetlerin vatandaşların ihtiyaçlarını tespit etme konusunda karşılaştığı güçlüklerden dolayı, birçok gelişmiş ülke koşulsuz hibe yöntemini kullanmaktadır. Bu tip transferler, Kanada, Avustralya, İngiltere, Japonya, Kore’de görülürken, Almanya’da eşitleme hibesi, mali kapasitesi ortalamanın üstündeki eyaletlerden mali kapasitesi ortalamanın altında olan eyaletlere doğru dağıtılmaktadır.

Yönetimler arası transferlerin dağıtılmasında görülen ahlaki tehlike ve mali disiplinsizlik kaygılarından dolayı, bu çalışma yeniden dağıtım kuralının gerekliliğini sorgulamaktadır. Özellikle, bu çalışma ihtiyari transferler (discretionary transfers) ile lineer yeniden dağıtım kuralının refah etkilerinin farklılıkları üzerine odaklanmaktadır. Bu kurala bağlı yeniden dağıtım mekanizması, eşitlik ve etkinlik özelliklerini kapsamaktadır. Diğer bir amaç ise, mali yerelleşme kurulumu altında yeniden dağıtım mekanizmasında etkinlik ve eşitlik özelliklerini göreceli refah etkileri açısından incelemektir. Mali yerelleşme, mali sorumlulukların ulus hükümetlerden ulus-altı hükümete devredilmesi olayıdır. Bu sorumluluk devri, etkinliği daha güvenilir bilgi toplanması yoluyla artırarak ve ulus-altı hükümetlerin arasında rekabet sağlayarak yapılmaktadır. Yerel hükümetler vatandaşların gerekliliklerini daha iyi belirleyebildiklerinden dolayı daha uygun bir şekilde gelirleri harcayabilmektir. Buna rağmen, merkezi hükümet bütün yerel hükümetlerin yönetmelikleri ve bütçesini organize etmektedir. Bir diğer deyişle, bölgeler arasında disiplini ve eşitliği ayakta tutabilmek için merkezi hükümetler ana düzenleyici ve denetleyici otoriteler olarak görev yapmaktadırlar. Yani, yerel hükümetler ile merkezi hükümet arasında bir etkileşim olmalıdır, fakat bu etkileşim literatürde eksiktir. Bu çalışma, merkezi hükümet, yerel hükümetler ve vatandaşlar arasında etkileşimin ortaya konması yoluyla bu eksikliği gidermeyi amaçlamaktadırlar.

Bu çalışmadaki model Chu ve Yang'in (2012) endojen büyüme modeli ve Akın ve diğerleri (2016)'nin yeniden dağıtım mekanizması ile benzerlikler içermektedir. Akın ve diğerleri (2016), mali yerleşmenin mali disiplin üzerine etkisini önceden belirlenmiş yeniden dağıtım kuralı çerçevesinde inceleyerek, bunu merkezi mali sistemle karşılaştırma yapmıştır. Akın ve diğerleri, mali yerleşmeyi mali disiplini pozitif bir şekilde etkilediğini, gelir dağılımının ise merkezi mali sistemde, mali yerleşme durumuna göre daha iyi durumda olduğunu göstermiştir. Modeldeki kamu malı tedarik kısmı Besley ve Coate (2003) 'un kamu malı tedarik modelinin genişletilmiş versiyonudur. Besley ve Coate' un çalışmasındaki kamu malı tedarik modeli statik ve vergi rekabetin olmadığı bir modeldir. Ayrıca, Chu ve Yang'in çalışmasında yer alan model, vergi rekabeti ve kamu malı yayılım özellikleriyle birlikte dinamik endojen büyüme modelidir. Bu çalışmanın Chu ve Yang'in çalışmasıyla temel farkı, vergi rekabetinin olduğu modellerde Wilson (1999)'in gerekli prosedür olarak tanımladığı yeniden dağıtım mekanizmasının olmasıdır. Vergi rekabeti ekonomide iki temel verimsizliğe neden olmaktadır. Bir sonraki paragrafta ve literatür taramasında bahsedileceği gibi, bu iki verimsizlikten ilki, verimsiz olacak kadar düşük seviyelerde kamu malı olmasıdır. Diğeri ise, yereller arasında sermayenin yanlış bölüştürülmesidir. Wilson, bu verimsizlikleri ancak merkezi bir otorite tarafından dağıtılan transferlerin düzeltebileceğini söylemiştir. Bizim modelimizde, merkezi hükümetin maliye politikası üzerinde direkt bir etkisi yoktur, transferler aracılığıyla bir etki yapmaktadır.

Diğer bir katkı ise, yönetimler arası transferlerin, maktu (lump sum) transferler haricinde, mali yerleşmenin olduğu teorik çalışmalarda yer almamasından ortaya çıkmaktadır. Merkezi hükümet belli miktarda transfer (lump sum transfers) vereceğini taahhüt ettiği zaman yerel hükümetlerin mali sorumluluklarını yerine getirip getirmediğine bakmadan sadece dikey dengesizliklerde azalma görülür. Fakat yüksek seviyeli bir otoriteden daha düşük seviyeli bir otoriteye aktarılan transferler, mali dengesizliklerin yok edilmesinde önemli bir araçtır. Daha önceden de belirtildiği üzere, Ma(1997) ve Shah(1995) iyi tasarlanmış yönetimler arası transfer özelliklerini

sıralamışlardı ve maktu transferlerin bu özellikleri sağlamadığı apaçık bir şekilde görülmektedir. Bundan dolayı, bahsedilen özellikleri taşıyan yeniden dağıtım kuralı ile birlikte vatandaşlar ile hükümetler arasında etkileşimin olması, literatüre önemli bir katkı olarak görülmektedir. Buna ek olarak, hangi ülke hangi özelliğe daha çok önem vermeli diğer önemli bir soru olup, bu çalışma bu soruya da cevap vermeyi amaçlamaktadır.

Wilson (1999)'a göre, yeterli miktarda kamu malı tedarigi veya yeterli miktarda sermaye dağıtımı, vergi rekabetinin olduğu bir ortamda görülmesi pek muhtemel değildir. Eğer merkezi bir otorite bölgeler arasında transferleri dağıtırsa, o zaman yeterli seviyelere ulaşılabilir. Wildasin (1986), bu tip yönetimler arası transferlere 'düzeltici yardım' olarak adlandırmaktadır. Wildasin, yönetimler arası transferlerin, vergi rekabeti sonucunda ortaya çıkan etkisizliklerden dolayı gerekli olduğunu iddia etmektedir. Söz konusu etkisizlikleri mali dışsallık olduğunu göstermesinin ardından, bu dışsallığın modele yönetimler arası transferlerin empoze edilmesiyle içselleştirildiğini ispatlamıştır. Buna ek olarak, Inman ve Rubinfeld (1996) federal ekonomiler için vergi politikası dizayn etmiştir. Düşük seviyeli hükümetlerin vergilendirme yetkisinden dolayı, ortaya çıkan etkisizlikleri ve eşitsizlikleri düzeltebilmek için merkez hükümet tarafından transfer dağıtım yöntemini önermişlerdir. Bu çalışmada yer alan vergi rekabeti sonucunda ortaya çıkan etkisizlikler, merkezi hükümet tarafından bir kural çerçevesinde transfer dağıtım yapılarak ortadan kaldırılmıştır.

Bu çalışmada lineer yeniden dağıtım kuralı iki kriteri dikkat almıştır: eşitlik ve etkinlik. Bu kural, Akin, Bulut-Cevik ve Neyapti (2016) makalesinde yer alan kural üzerinde birkaç değişiklik yapılarak kullanılmıştır. Eşitlik özelliğinin amacı, yerel hükümetlerin belirli düzeyde kamu malı sunmasına imkan vermek amacıyla kapasitelerini eşitlemektir. Eğer bölgenin gelir seviyesi önceden belirlenen hedef seviyesinin altında kalırsa, transfer miktarı destek amaçlı artırılmaktadır. Etkinlik özelliğinin amacı ise,

vergi geliri hedeflemesi yoluyla yerel hükümetlere mali disiplini sağlamaktır. Eğer yerel hükümet önceden belirlenen vergi gelir hedefini tutturamazsa, merkezi hükümet söz konusu yerel hükümeti cezalandırma amacıyla transfer miktarını düşürür. Kısacası, bu özelliğin amacı vergi toplama çabasını yükseltmektir.

Sonuç olarak, bu çalışmada yönetimler arası transfer kuralının yerelleşmiş mali politika çerçevesinde refah özellikleri araştırılmaktadır. Bu araştırma, kural olmadığı durum ile iki özelliğe (eşitlik ve etkinlik) de sahip kuralın olduğu durumların refah karşılaştırmasını; sadece eşitlik özelliğinin olduğu ve sadece etkinlik özelliğinin olduğu kuralların refah karşılaştırmasını yapmaktadır. Eşitlik ve etkinlik özelliklerinin kapsandığı tüm kural durumunda, merkezi hükümet yeniden dağıtım parametrelerini belirleme yoluyla transfer miktarını dolaysız yoldan karar vermektedir. Fakat, kuralın olmadığı durumda, yerel hükümetler vatandaşlardan topladıkları vergileri harcamaktadırlar. Bu karşılaştırma, refah açısından kuralın gerekliliğini ispatlaması açısından önemlidir. Buna ek olarak, eşitlik özelliğinin olmaması durumunda merkezi hükümet sadece vergi toplama çabalarını dikkate alırken etkinlik özelliğinin olmaması durumunda merkezi hükümet sadece bölgeler arasındaki gelir eşitliğini dikkate almaktadır. Söz konusu refah karşılaştırması, merkezi hükümetin hangi durumlar altında (örneğin yüksek sermaye hareketliliği, düşük kamu mali yayılımı, gibi...) hangi özelliğe daha çok ağırlık vermesi gerektiğine cevap verebilmemizi sağlayacaktır.

Sonuçlara göre, düşük sermaye hareketliliği altında eşitlik özelliğinin olmaması durumunda, etkinlik özelliğinin olmaması durumuna göre daha yüksek refah seviyesi görülmüştür. Yani, düşük sermaye hareketliliğinin olduğu durumda merkezi hükümet, yeniden dağıtım kuralında etkinlik özelliğine eşitlik özelliğine oranla daha çok ağırlık vermesi gerekmektedir. Ayrıca, tüm kural durumunda kuralsız duruma göre, daha yüksek refah seviyesi görülmüştür. Bu sonuç yeniden dağıtım mekanizmasının gerekliliğini göstermektedir. Bu bulgu Sanguinetti ve Tomassi (2004) ile Wildasin (1984) çalışmalarıyla tutarlıdır.

Model

Bu model sürekli zaman çerçevesinde A-K tipi endojen büyüme modelidir. Model merkezi hükümet, yerel hükümet ve vatandaşlardan oluşmaktadır. Bu üç ajan arasında belirli olaylar çerçevesinde etkileşim olmaktadır. Vergi rekabeti ile birlikte bölgeler arasında kamu malı yayılımına izin verilmiştir. Sermaye, hareketli ve maliyetlidir. Ayrıca, sermaye geliri hükümetin tek gelir kaynağıdır.

Bu çalışmada önceden de belirtildiği üzere, mali yerelleşme çerçevesinde lineer yeniden dağıtım kuralının refah etkilerini incelenmiştir. Modelde, vatandaşlar, yerel hükümet, merkezi hükümet olmak üzere birbirleriyle etkileşim içerisinde olan 3 tip ekonomi ajanı bulunmaktadır. Merkezi hükümet, transfer miktarını kural çerçevesinde organize ederken yerel hükümet maliye politikasını belirlemektedir.

Yerel hükümetler, politikalarını bağımsız, eş zamanlı ve işbiriksiz bir şekilde belirlemektedirler. Yerel hükümetler, merkezi hükümetin yeniden dağıtım kuralı verili bir şekilde yerel vatandaşların refahını maksimize etmeyi hedeflemektedir. Bölgeler arasında yerel hükümetlerin içselleştiremediği kamu malı yayılımı bulunmaktadır. Ayrıca her yerel hükümet sermaye getirisi üzerinden kendi vergi oranını belirlediğinden dolayı, yerel hükümetler arasında vergi rekabeti görülmektedir. Bir diğer özellik ise, yerel hükümetler tamamıyla kar amacı gütmeyen hükümet tipinde olmayabilir. İleride ayrıntılı bir şekilde anlatılacağı üzere, politikacılar (yerel hükümetler) toplanan vergi gelirin belli bir kısmını kendi bencil amaçları (self-interested purposes) için kullanabilirler. Bu da literatürde bilinen rant kollayan hükümet (rent-seeking) olarak bilinmektedir. Merkezi hükümetin maliye politikasında direkt bir rolü yoktur, amacı sadece anlık eşit bütçe kısıtını sağlayarak transfer miktarlarını belirlemektir. Vatandaşlar, tüm hayatlarının faydasını maksimize etmeyi hedeflemektedir. Olayların akışı şu şekildedir:

- Merkezi hükümet, transfer kuralını uygulayacağını ilan ederek, ilgili parametreleri bulmaktadır.

- Yerel hükümet, maliye politikaları değişkenlerini belirlemektedir.
- Politika değişkenleri veri iken, vatandaşlar faydalarını maksimize etmektedirler.

Birey (Vatandaş) Problemi

Bireyler coğrafi açıdan farklı fakat simetrik bölgelerde yaşamaktadırlar. Kolaylık olması açısından, eşit nüfusa sahip iki bölge olduğunu varsaymaktayız; yerli ve komşu (yabancı) eyaletler gibi... Bireyler fayda fonksiyonlarını maksimize etmeyi amaçlamaktadırlar. Birey fayda fonksiyonu da özel tüketim, yerli bölgedeki kamu malı seviyesi ve komşu bölgedeki kamu malı seviyesi değişkenlerinden oluşmaktadır. Bireyin komşu bölgesindeki kamu malı seviyesinden aldığı fayda seviyesi, pozitif yayılım derecesine bağlıdır. Söz konusu derece sıfır (0) ile bir (1) arasında olmalıdır. Eğer derece 'sıfır' ise, birey komşu bölgedeki kamu malı seviyesinden fayda sağlamazken, derecenin 'bir' olması bireyin yaşadığı bölgedeki kamu malı seviyesi ile komşu bölgedeki sağlanan kamu malı seviyesinden alınan faydanın eşit olması demektir. Söz konusu kurgu, Besley ve Coate'un (2003) kamu malı tedarik modeli ile benzerlikler göstermektedir.

Bireyler, faydalarını maksimize ederken ne kadar tüketeceklerini ve ne kadar tasarruf edeceklerine karar verirler. Akışkan bütçe dengesi, gelir, tasarruf ve harcamalar arasındaki klasik net dengeden oluşmaktadır.

Standart A-K modelinde olduğu gibi, sermaye, beşeri sermaye, somut ve somut olmayan sermaye tiplerinden oluşmaktadır. (Rebelo,1991) Modelde, bireyler yaşadıkları bölgeden diğer bir bölgeye taşınamazlar, yerlerini değiştiremezler. Vergi gelirleri sadece sermaye gelirleri üzerinden olduğundan dolayı, hareketli sermaye yoluyla vergi rekabeti gözlenir. Sermaye sahipliğinden ziyade, vergi, sermayenin sağlandığı yer dikkate alınarak toplanmaktadır. Bu tip vergileme yöntemi 'kaynağa dayalı vergilendirme' olarak adlandırılmaktadır. Ayrıca, sermaye hareketliliğine izin verilmesinden dolayı, iki bölgede de kişi başı sermaye seviyeleri farklılık gösterir.

Bütçe kısıtındaki bir diğer terim de maliyet fonksiyonudur. Söz konusu maliyet fonksiyonu, yabancı bir markete yatırım yapılmasından kaynaklanmaktadır. Maliyet, karşılaşılan belirsizlikler, yabancı legal sorunlar, yabancı ülke spesifik riskler gibi... veya bilgi toplarken karşılaşılan maliyetler gibi düşünülebilir. Kısacası, maliyet, yabancı sermaye paylaşımı sırasında karşılaşılan tüm uyumsuzlukları kapsamaktadır. Bu çalışmada kullanılan maliyet fonksiyonunun yapısı Persson ve Tabellini (1992), Lejour ve Verb (1997) ve Chu ve Yang (2012) ile benzerlikler göstermektedir. Sermaye hareketliliğin derecesi, bu maliyet fonksiyonunu negatif bir şekilde etkilemektedir. Eğer sermaye mükemmel hareketli (perfectly mobile) bir yapıya sahipse, maliyet sıfır olacaktır, buna rağmen sermaye tamamen hareketsiz (perfectly immobile) ise maliyet sonsuz olacağından dolayı, sermayeyi hareket ettirmek pek rasyonel bir hareket olmayacaktır. Sonuçlar bölümünde de bahsedileceği üzere, sermaye hareketlilik derecesi yükseldikçe vergi oranı düşmektedir. Bu sonuç, Deveraux ve diğerleri (2008) ve Winner (2005) çalışmalarıyla tutarlıdır. Ayrıca, maliyet fonksiyonu komşu bölgeden alınan sermayenin toplam sermayeye oranına göre artan ve dışbükey özelliklerini göstermektedir.

Yerel Hükümet Problemi

Sadece bireylerin faydasını değil, aynı zamanda kendi bencil isteklerini de önemseyen politikacılar, politika yapıcı hükümeti yürütürler. Yani, yerel hükümet, sadece bencil veya sadece kar amacı gütmeyen veya ikisinin arasında bir yapıya sahip olabilir. Bu çalışma politikacıların nasıl ve neden seçildiği kısmıyla ilgilenmemektedir. Fakat vergi gelirlerinin bir kısmına politikacılar kendi bencil istekleri çerçevesinde, yeniden seçilme harcamaları gibi, kullanabilmektedir. (Lockwood , 2006) Yerel hükümet, kendi objektif fonksiyonlarını sermayenin hareket yasası ve anlık denk bütçe kısıtlarını sağlayarak maksimize etmektedir. Bu maksimizasyon sırasında yerel hükümet, vergi oranını, kamu malı seviyesini ve rant seviyesini (rent- seeking level) belirlemektedir.

Anlık denk bütçe kısıtına bakıldığı zaman, merkezi hükümetten dağıtılan transfer, yerel hükümet tarafından ya kamu malı tedariki için ya da kendi bencil harcamaları için kullanılabilir.

Merkezi Hükümet Problemi

Merkezi hükümetin, maliye politikaları üzerinde sadece transfer kuralı parametrelerini belirlemek yoluyla dolaylı etkisi vardır. Bu çalışmada kolaylık olması açısından iki coğrafi açıdan farklı ama simetrik bölgeler olduğu varsayılmaktadır. Merkezi hükümet optimizasyon problemi çözmez, sadece transfer parametreleri için muhtemel değerleri bulmayı ve dolayısıyla bölgelere dağıtılacak transfer miktarlarını belirlemeyi amaçlamaktadır.

Bütün yereller vatandaşlardan topladıkları vergi gelirlerini ortak bir havuza attığı varsayımı altında merkezi hükümet, söz konusu havuzdan lineer yeniden dağıtım kuralı çerçevesinde hangi yerele ne kadar transfer dağıtacağına karar vermektedir.

Yeniden Dağıtım Mekanizması:

Mali dengesizliklerin azaltılmasının bir yolu modele yeniden dağıtımın empoze edilmesidir. Gelişmekte olan ülkelerde, uygun mali kurumsal mekanizma eksikliği söz konusu dikey ve yatay mali dengesizliklerin refaha etkisini arttırmaktadır. Ma (1997), 9 ülkeyi incelemiştir ve etkili transfer mekanizmasının 4 temel kriteri kapsamı gerektiğini söylemiştir: gelir yeterliliği, şeffaflık ve durağanlık, yerel vergi çabası, eşitlik. Yerel bölgelerin vatandaşlara karşı olan sorumluluklarını karşılamak için belli bir oranda gelir yeterliliği gerekmektedir. Şeffaflık ve durağanlık kriteri, yerel hükümetlerin bütçelerini uzun vadeli yerel planları doğru anlaşılabilir bir şekilde yapılması açısından önemlidir. Yerel vergi çabası ve harcama kontrolü kriterinde amaç, vergi toplama çabasını maksimum seviyeye çıkarmak ve mali açıkları engellemektir. Ma (1997)'nin vurguladığı eşitlik kriteri ise, yerel mali ihtiyaç ve kapasitelere göre transferlerin değişmesi gerektiği yönündeki gereklilikten ortaya çıkmıştır. Sanguinetti

ve Tomassi (2004), yerel hükümetler arasında mali etkinlik ve mali disiplini geliştirmek için transfer kuralını, ihtiyari transfere tercih edilmesi gerektiğini göstermiştir. Literatürde bulunan söz konusu sonuçlara dayalı olarak, Akin, Bulut-Cevik ve Neyapti (2016) eşitlik ve etkinlik özelliklerini içeren yeniden dağıtım kuralı oluşturmuşlardır.

Etkinlik kısmında vergi gelirine konulan hedef yoluyla mali disiplini sağlanması amaçlanmıştır. Eşitlik kısmında ise yereller arasındaki yatay dengesizlikleri azaltmak ve hatta yok etmek amaçlanmaktadır. Bu çalışmada kullanılan yeniden dağıtım kuralı Akin ve diğerleri (2016) makalesinden bazı farklılıklar içermektedir. Onların çalışmasında vergi toplama çabası üzerine odaklanılırken, bu çalışmada vergi geliri hedefi kullanılmıştır. Gözlemlenen vergi toplama çabası yerine gerçekleşen vergi geliri kullanılmıştır.

Yeniden dağıtım kuralında bu iki özellik şu şekilde çalışmaktadır; eğer yerel hükümet vergi gelirleri hedef seviyesine ulaşamaz ise, merkezi hükümet söz konusu yereli transfer miktarını düşürerek cezalandırmaktadır. O yüzden bu etkinlik özelliğini kullanılırken yazılan ‘p’ parametresine cezalandırma parametresi denmektedir. Ayrıca, eğer yerel hükümet gelir hedef seviyesinin altına düşüyorsa, merkezi hükümet bu kaybı telafi etmek için transfer miktarını arttırmaktadır. O yüzden burada kullanılan parametreye ‘gelir telafi edici parametre’ denmektedir.

Denge

Bu çalışmada kullanılan denge kavramı, Ortiguiera ve diğerleri (2012), Krisell ve Rios-Rull (1999) ve Klein ve diğerleri (2008) çalışmalarında kullanılan denge kavramı ile benzerlikler göstermektedir. Kamu ve özel sektör arasındaki etkileşimin nasıl olduğu bilgi tanımının belirlenmesinde etkili olmuştur. Bu çalışma, bireylerin ve hükümetlerin sıralı olarak hareket etmeleri çerçevesinde mükemmel Markov dengesi (Markov perfect equilibrium) üzerine odaklanmaktadır.

Diğer önemli nokta, hükümetlerin bu dönemki vergi oranını, kamu malı ve rant seviyelerini belirlerken gelecek davranışları hakkında öngörü sahibi olmalarıdır. Diğer bir deyişle, merkezi hükümet transfer seviyelerini belirlemelerinin ardından, yerel hükümetler vergi oranını, kamu malı ve rant seviyelerini belirlemektedir. Söz konusu mali politika değişkenleri herkes tarafından bilindikten sonra, bireyler tüketim ve tasarruf seviyelerini belirlemektedir. Hükümetler, Stackelberg oyuncuları olarak düşünülebilir ve bu dönemki mali politikanın birey davranışlarına olan etkilerini tahmin edebilmektedirler.

Çözüm

Model kısmında, merkezi hükümet, yerel hükümet ve vatandaşların problemleri ayrıntılı bir şekilde anlatıldı. Söz konusu üç ajanın oyun çözümü, geriye doğru tümevarım (backwards induction) yöntemiyle yapılmaktadır. Yani, ilk önce vatandaş problemi, daha sonra yerel hükümet ve en son olarak da merkezi hükümet problemi çözülmüştür. MATLAB yardımıyla analitik çözüm bulunabilmektedir. Yeniden dağıtım mekanizmasının özellikleri üzerinden farklı durumlar ortaya çıkmaktadır. Birinci durum, transfer kuralı sadece etkinlik özelliğine sahipken, ikinci durum eşitlik özelliğinin olmasıdır. Üçüncü durumda ise, yeniden dağıtım kuralında iki özellik de bulunmaktadır. Son durumda ise yeniden dağıtım için bir kural bulunmamaktadır. Yerel hükümet vergi geliri olarak topladığı kadarını harcayabilmektedir. Bu durumlar yerel hükümet probleminde değişikliklerden kaynaklandığı için birey problemlerinde farklılık göstermemektedir. Ayrıca modelde yerellerin simetrik bir yapıya sahip olması önemli bir varsayımdır. Bu varsayım vergi rekabetiyle birlikte, Nash dengesi olarak eşit vergi oranlarına neden olmaktadır. Wildasin (1988), mali rekabet içerisinde olan bölgeler için Nash dengelerini hesaplamıştır, ve özel bir durum olarak birbirine benzer iki bölgenin yani simetrik iki bölgenin sonuçlarına ulaşmıştır. Buna göre, eşit vergi oranı ve eşit kamu harcamalarını Nash dengesi olarak bulmuştur. Wilson (1991)'in çalışmasındaki amacı hareketli sermaye ve sermaye vergilendirmesi altında nüfus açısından iki farklı bölge arasındaki Nash dengesini bulmaktır. Özel bir durum olarak

iki aynı bölge için eşit vergi oranlarını ve eşit yerel kamu malı bulmuştur. Bu durumun altında yatan neden şu şekilde açıklanabilir: 'A' bölgesindeki yerel hükümet yerel vergi oranlarında artış yaptığı zaman, bütün bölgeler simetrik olduğundan dolayı tüm sermaye başka bölgeye kaymaktadır. Söz konusu durum, 'A' bölgesinin tüm kaynaklarını kaybetmesine neden olmaktadır. Yani, bölge 'A' nın vergi oranlarını artırıcı bir isteği olmayacaktır. Sonuç olarak, simetrik olan 'A' ve 'B' bölgeleri için vergi oranları eşit olacaktır ve hiçbir yerel hükümetin vergi oranlarını değiştirmek gibi bir güdüsü olmayacaktır.

Basar ve Olsder (1999), Stackelberg diferansiyel oyunlar için bir çözüm yolu önermiştir. Oyunda bir lider ve takip edici olduğundan dolayı oyuncular birbirleriyle sıralı bir şekilde etkileşim halindedirler. Yani takip edicinin (vatandaş) en iyi cevabi liderin (hükümet) probleminin içine kısıt halinde yazılması gerekmektedir. Alternatif olarak, Xie (1997) zaman tutarlı politikalar için, takip edici modelden bulunan optimal değerlerin analitik çözümleri, lider modelinin içerisine direkt yerleştirileceğini kanıtlamıştır. Böylelikle, fazladan kısıt olan en iyi cevap fonksiyonu ile uğraşılmamış olunacaktır. Yerel hükümet problemine göre, optimal vergi oranı, zamandan bağımsız olarak bulunmuştur. Bu sebepten dolayı, yerel hükümetin zaman tutarlı hükümet politikalarından bahsedilebilir. Bu çalışmada, Xie'nin önerdiği analitik çözümlerin lider fonksiyonuna yazılma yöntemi tercih edilmiştir.

Simulasyon

Politika sonuçları üretebilmek için, modelde yazılan bazı parametrelerin maliye politika değişkenleri üzerine etkileri incelenmiştir. Modelin analitik çözümleri, ayrıntılı bir şekilde bulunmuştur, fakat bulunan sonuçlar çok karışık ve yorumlanması zor denklemler olmasından dolayı simülasyonlardan yararlanılmıştır. Simülasyon yapılması için bazı egzogen değişkenlere, değerler veya uygun aralıkların yazılması gerekmektedir.

Literatürde ayırık zamanlı analizlerde kullanılan yıllık iskonto oranı (discount rate) 0,99 olurken bu değere karşılık gelen sürekli zaman analizlerindeki iskonto oranı 0,01'dir. Dünya Bankası İstatistiklerinden ABD datasına bakıldığında sermayenin gelire oranı 2,962 olarak bulunmuştur. A-K tipi endojen büyüme modeli kullanıldığından dolayı, söz konusu oranın tersi teknoloji seviyesine denk gelmektedir. Bu sebepten dolayı, teknoloji seviyesi 0,3376 olarak alınmıştır. Başlangıç sermaye seviyesi, analizlerde kolaylık sağlaması açısından 1 olarak alınmıştır. Bu seviyenin artması değişkenlerin değerlerinde artışlara neden olurken, davranışsal değişimler veya değişken oranlarında değişiklikler görülmemektedir. Bencillik derecesi ve pozitif yayılım derecesi, modelde anlatıldığı üzere sıfır ile bir arasında değişim göstermektedir. Sermaye hareketliliği modelde sıfır ile sonsuz arasında değişebilmektedir. Sermaye hareketliliğinin sıfır olması, sermaye hareketsizliğine işaret ederken sonsuz olması sermayenin mükemmel hareketli olduğunu göstermektedir. Fakat programa sonsuz değeri tanımlanamayacağı için rastgele büyük bir sayı atanmıştır, Davranışsal etkilerin görülebilecek kadar büyük sayı olan 1000 değeri verilmiştir. Ayrıca hedef vergi oranı olarak sıfır ile sıfır virgöl beş arasında değerler verilmiştir. Bunun yanısıra hedef gelir oranı da hedef teknoloji seviyesi ile uyumlu seçilmiştir.

Birinci Durum

Yeniden dağıtım mekanizmasında eşitlik özelliği olmadığı durumda vergi oranı zamandan bağımsız çıkmıştır. Ayrıca, optimal kamu malı seviyesi, sermaye seviyesine, iskonto oranına, bencillik derecesine, sermaye hareketlilik oranına, teknoloji seviyesine ve vergi oranına bağlıdır. Optimal rant seviyesi de optimal kamu malı seviyesinde olduğu gibi sermaye seviyesine, iskonto oranına, sermaye hareketlilik oranına, teknoloji seviyesine ve vergi oranına bağlıdır. Yeniden dağıtım mekanizmasında sadece etkinlik özelliği olduğundan dolayı, merkezi hükümet sadece ceza parametresini belirlemektedir. Söz konusu parametre de bencillik seviyesine, sermaye hareketliliği derecesine, iskonto oranına ve hedef vergi seviyesine bağlıdır.

Eşitlik özelliğinin olmadığı durumda, sermaye hareketlilik derecesi arttıkça vergi oranı düşmektedir, yani vergi oranı ile sermaye hareketliliği ters orantılıdır. Bunun nedeni olarak da şu gösterilebilir: sermaye hareketliliği arttıkça sermayeyi hareket ettirmenin maliyeti düşmektedir. Yerel hükümetin tek gelir kaynağı, sermaye gelirleri olmasından dolayı, yerel hükümetler sermaye kaybetmemek için, vergi oranını düşürmektedir. Kamu malı seviyesinin sermaye hareketliliğine göre türevinin negatif çıkması, bize kamu malı seviyesi ile sermaye hareketliliği arasındaki ters orantılı ilişki olduğunu göstermektedir. Yani, sermaye hareketliliği arttırdıkça sermayenin hareket maliyeti düştüğünden ve vergi geliri düştüğünden dolayı kamu malı yatırımları düşmektedir. Aynı şekilde vergi oranının düşmesi vergi gelirlerini düşürmektedir. Bu da kamu malı seviyesinde olduğu gibi rant seviyesini de düşürmektedir. Böylelikle, politikacı kendi çıkarları için yapacağı harcamaları gelir eksikliğinden dolayı azaltmaktadır. Söz konusu negatif ilişkiler, cezalandırma parametresi veya bencillik derecesinin değişmesi durumunda bile değişmemektedir. Ayrıca, sermaye seviyesi ile sermaye hareketliliği derecesi arasındaki ilişki, modelin yapısı kaynaklı olarak vergi oranı ile sermaye hareketliliği derecesi arasındaki ilişkinin tersidir.

Bireylerin fayda fonksiyonu içerisinde bulunan pozitif kamu malı yayılım derecesi, bireylerin komşu bölge kamu malı seviyesinden faydalanma derecesini göstermektedir. Söz konusu derecenin sıfır olması, bireyin komşu bölgenin kamu malından fayda almadığı şeklinde yorumlanırken, derecenin bir olması komşu bölge kamu malından alınan fayda ile yaşadığı bölgedeki kamu malı seviyesinden alınan faydanın eşit olması şeklinde yorumlanmaktadır. Eşitlik özelliğinin yeniden dağıtım kuralı içerisinde olmadığı durumda, pozitif kamu malı yayılım derecesinin politika değişkenleri üzerinde etkisi olmadığı görülmüştür. Sadece fayda fonksiyonunu etkilediği görülmüştür.

Politikacının bencillik derecesi, sıfır ile bir arasında değer almaktadır. Bencillik derecesinin 'bir' olması, yerel hükümetin sadece kendini düşünen, vatandaşların

faydalarını göz ardı eden hükümet olduğunu gösterirken, bencillik derecesinin ‘sıfır’ olması kar amacı gütmeyen, sadece vatandaşlarının faydalarını gözeten hükümet şeklinde yorumlanmaktadır. Transfer kuralında sadece etkinlik özelliğinin olduğu durumda, vergi oranının bencillik oranına göre türevine bakılmıştır ve pozitif bulunmuştur. Yani, yerel hükümetin başındaki politikacı bencilleşmeye başladıkça, yerel hükümet, vatandaşların faydasını daha az gözetmeye başladığından dolayı vergi oranlarında artış görülmüştür. Diğer bir gözlem ise sermaye hareketliliğinin bu ilişkiye olan etkisidir. Sermaye hareketliliği arttıkça, vergi oranı ile bencillik derecesi arasındaki ilişki zayıflamaktadır. Sermaye hareketliliği arttıkça, bencillik derecesinden bağımsız bir şekilde, sermaye kaybetmemek için yerel hükümetlerin vergi oranlarını düşürme eğilimi bulunmaktadır. Bencillik derecesindeki artışın vergi oranına yaptığı artış, sermaye hareketliliği arttıkça vergi oranındaki düşüş üzerindeki baskın etkisi sermaye hareketliliği arttıkça yok olmaktadır. Yani bencillik derecesi ile vergi oranı arasındaki pozitif ilişki sermaye yeterliliği arttıkça azalmaktadır. (ikinci dereceden türev)

Bencillik derecesi arttıkça kamu malı seviyesinin sermaye seviyesine oranı düşmektedir. Bencillik derecesi arttıkça yerel hükümetlerin vergi oranlarını arttırmasından dolayı vergi gelirlerinin artmasına rağmen, kamu malı seviyesi düşmektedir. Çünkü yerel hükümet vatandaşların faydasını daha az düşündüğünden dolayı kamu malı yatırımlarını azaltmıştır, kendi özel şahsi harcamalarını arttırmıştır.

Diğer bir gözlem ise kamu malı seviyesi ile bencillik derecesi arasındaki negatif ilişkinin, sermaye hareketliliği arttıkça kaybolmasıdır. Söz konusu negatif ilişkinin kaybolmasının altında iki önceki paragrafta belirtildiği vergi oranındaki artış ve düşüş oranlarının birbirine karşı olan baskınlıkları yatmaktadır.

Eşitlik ilkesinin olmadığı transfer kuralında sadece etkinlik özelliği bulunmaktadır. Bu özellik çerçevesinde mali disiplinin sağlanabilmesi için dışsal bir şekilde vergi

gelirlerine bir hedef konmaktadır. Söz konusu hedefin konulması, yerel hükümetlerin bu gelirleri toplamak niyetiyle konulan hedef çerçevesinde vergi oranı belirlemesini sağlamaktadır. Söz konusu durum vergi gelirlerinde oynaklığı azaltmasına durağan ve tahmin edilebilir bir vergi politikasına neden olmaktadır. Vergi oranının hedef vergi oranına göre türevinin pozitif çıkması bu düşüncüyü desteklemektedir.

İkinci Durum

Yeniden dağıtım mekanizmasında etkinlik özelliğinin olmadığı durumda birinci durumda olduğu gibi vergi oranı zamandan bağımsız çıkmıştır. Optimal vergi seviyesi sadece teknoloji düzeyine ve sermaye hareketlilik derecesine bağlı olduğu ortaya çıkmıştır. Kamu malı ve rant seviyeleri de sermaye seviyesine, bencillik seviyesine, gelir telafi edici parametreye, hedef gelir seviyesine ve teknoloji seviyesine bağlı bulunmuştur. Transfer kuralında sadece eşitlik özelliği olduğundan dolayı, merkezi hükümet sadece gelir telafi edici parametresini belirlemektedir. Söz konusu parametre de sermaye hareketliliği derecesine, teknoloji seviyesine ve hedef gelir seviyesine bağlıdır.

Birinci durumda olduğu gibi, bu durumda da sermaye hareketlilik derecesi ile vergi oranı arasındaki ilişki incelenmiştir ve negatif ilişki görülmüştür. Sermaye hareketliliği arttıkça, maliyetin düşmesine ve bölgelerin kolayca sermaye kaybına yok açacaktır. Bu sermaye kaybını azaltmak için yerel hükümetler vergi oranını düşürürler. Burada dikkati çeken gözlem, bencillik derecesinin vergi oranını etkilememesidir. Yani, transfer kuralında sadece eşitlik özelliğinin bulunduğu durumda, yerel hükümetin başındaki politikacının bencillik derecesinin artması veya azalması, vergi oranında bir değişikliğe neden olmayacaktır.

Birinci durumda olduğu gibi, kamu malı ve rant seviyeleri ile sermaye hareketlilik derecesi arasında negatif ilişki gözlenmiştir. Buna sebep vergi gelirlerinin, sermaye hareketliliğinden dolayı azalmasıdır. Bencillik seviyesi, vergi oranı üzerinde bir

etkisinin olmamasına rağmen, kamu malı seviyesini ters yönde, rant seviyesini ise aynı yönde etkilemektedir.

Vergi oranı, değer olarak ‘sıfır’ ile ‘bir’ arasında olmalıdır. ‘Bir’ değerini geçemez, çünkü vergi miktarı sermaye gelirini aşamaz. Bu sebepten dolayı, grafikler incelendiğinde, yeniden dağıtım kuralı sadece eşitlik özelliğini taşıdığına, düşük sermaye hareketliliği gözlemlendiğinde optimal vergi oranı seçiminde bazı yanıltıcı sonuçlar ortaya çıkabilir.

Üçüncü Durum

Üçüncü durumda, yeniden dağıtım kuralında hem eşitlik hem de etkinlik özelliği bulunmaktadır. Diğer iki durumda olduğu gibi bu durumda da optimal vergi oranı zamana bağlı çıkmamıştır. Ayrıca, optimal kamu mali ve rant seviyeleri, sermaye seviyesine, iskonto oranına, bencillik derecesine, sermaye hareketlilik oranına, teknoloji seviyesine ve vergi oranına bağlıdır.

Vergi oranı, kamu malı seviyesi ve rant seviyesi ile sermaye hareketliliği arasındaki negatif ilişkiler bu durumda da görülürken bencillik seviyesinin vergi oranının pozitif yönde etkilediği görülmüştür.

Dördüncü Durum

Son durumda, transfer kuralı bulunmamaktadır. Yani, yerel hükümet, vatandaşlardan topladığı vergi gelirini merkezi hükümete aktarmaz, ne kadar topladıysa onu harcar. Vergi oranının zamana karşı bağımsız olması bu durumda da değişmemiştir. Aynı şekilde diğer politika değişkenlerinin sermaye hareketliliğine, bencillik derecesine ve hedef değerlerine olan tepkileri değişmemiştir.

Refah Karşılaştırması

Refah, vatandaşın şu anki iskonto edilmiş hayat boyu faydası olarak tanımlanmaktadır. Vatandaşın toplam faydası, kendi tüketiminden aldığı, yaşadığı bölgede sağlanan kamu malından aldığı ve komşu bölgenin kamu malından aldığı faydalardan oluşmaktadır.

Transfer kuralına eşitlik ve etkinlik özelliklerinin ayrı ayrı eklendiği durumlar için refah seviyeleri hesaplanmıştır. Bu refah seviyelerinin karşılaştırmasının sermaye hareketliliği derecesine bağlı olduğu ortaya çıkmıştır. Sermaye hareketliliğinin düşük olduğu durumda, eşitliğin olmadığı durumda hesaplanan refah seviyesi, etkinliğin olmadığı durumda hesaplanan refah seviyesine göre yüksek çıktığı görülmüştür. Buna sebep olarak şu gösterilebilir: Etkinlik olmadığı durumda sermaye hareketlilik derecesinin vergi oranı üzerindeki etkisi diğer duruma göre daha yüksektir. Böyle bir karşılaştırmanın ilk kez yapılmasından dolayı, literatürde bu sonucu onaylayacak ya da eleştirebilecek bir çalışma bulunmamaktadır. Literatürde ilk defa böyle bir model altında etkinlik eşitlik tartışması yapılmaktadır.

Eşitlik özelliğinin olmadığı durumda, transfer kuralında sadece etkinlik özelliği bulunmaktadır, yani vergi gelirleri için bir hedef bulunmaktadır. Önceden de belirtildiği gibi, yerel hükümetler, merkezi hükümetten gelen transferlerin düşmemesi için hedef vergi seviyesini tutturmaya çalışacaktır. Bu sebepten dolayı, diğer duruma göre daha az değişen bir refah eğrisi görülmektedir. Yani, etkinlik özelliğinin olmadığı durumda, vergi oranlarını daha geniş bir aralıkta hareket ettirdiğinden dolayı, aynı geniş aralık refah seviyesinde de gözlenmiştir. Sonuç olarak, düşük sermaye hareketliliğinin gözlendiği durumda merkezi hükümet, etkinlik özelliğine eşitlik özelliğine oranla daha fazla ağırlık vermesi gerektiği şeklinde yorumlanabilmektedir.

Bir diğer refah karşılaştırması ise etkinlik ve eşitlik özelliklerinin olduğu transfer kuralı ile transfer kuralının olmadığı durumların karşılaştırmasıdır. Bir önceki karşılaştırmanın tersine, bu iki durum arasında refah farklılıkları hiçbir dışsal değişkene

bağlı değildir. Transfer kuralının olduğu durumda ortaya çıkan refah seviyesi, transfer kuralının olmadığı durumda ortaya çıkan refah seviyesine göre daha yüksektir. Bu sonuç, yeniden dağıtım mekanizmasının yani transfer kuralının refah seviyeleri açısından gerekliliğini göstermektedir.

Eşitlik ve etkinlik özelliklerinin olduğu durumda, vergi gelirleri ve gelir seviyeleri için hedef konmaktadır. Fakat, yeniden dağıtım kuralı olmayan durumda, yerel hükümetler optimal vergi oranını, bahsedilen hedef seviyelerinden bağımsız bir şekilde belirlemektedirler. Böylelikle, transfer kuralı olduğu durumda vergi oranlarının kurlsız duruma göre daha yüksek olduğu görülmüştür. Bu durum ilk bakışta genel kanının dışında bir bulgu gibi gözükse de, fayda fonksiyonunun yapısı gereği olduğu görülmüştür. Düşük vergi oranları bireylerin faydasında harcanabilir gelirdeki artıştan dolayı bir iyileştirmeye neden olmaktadır. Fakat, düşük vergi oranları aynı zamanda düşük kamu malı yatırımları anlamına gelmektedir. Bireyin fayda fonksiyonu sadece tüketimden değil, aynı zamanda yaşadığı ve komşu olduğu bölgelerin kamu malı seviyelerinden oluştuğu da unutulmamalıdır. Düşük vergi oranları tüketimi arttırabilir ama aynı zamanda kamu malı seviyesini de düşürmektedir. Kamu malındaki bu düşüş, tüketimdeki artışa göre daha baskın olmasından dolayı refah seviyesinde düşük vergi oranına rağmen refah seviyesi daha az seviyede görülmüştür.

Sonuç

Gelişmiş ve gelişmekte olan ülkelerin yönetimler arası transferlerin yapısı hakkında geniş bir literatür bulunmaktadır. Her ülkenin kendine has özelliklerinin olması, söz konusu transferlerin de ülkeye özel bir şekilde tasarımına ve uygulanmasına neden olmaktadır. Buna rağmen, yönetimler arası transferlerin amacı, her ülke için aynıdır: mali dengesizlikleri ortadan kaldırmak, bölgeler arasındaki dışsallıkları yoketmek ve yönetsel zayıflıkları düzeltmektir. Bu bilgiler ışığında Akin ve diğerleri (2016), eşitlik ve etkinlik özellikleri çerçevesinde bir yeniden dağıtım kuralı oluşturmuşlardır. Bu çalışma, mali yerleşmenin görüldüğü ekonomilerde, bu transfer özelliklerinin

refah üzerine etkilerini incelemektedir. Çalışmadaki model, vatandaşlar, yerel hükümetler ve merkezi hükümet arasında etkileşimi içermektedir. Söz konusu etkileşim, bu çalışmanın en önemli katkılarından birisidir.

Model, sürekli zaman çerçevesinde A-K tipi endojen büyüme modelidir. Bölgeler arasında, hareketli sermaye sayesinde vergi rekabeti görülmektedir. Ayrıca, pozitif kamu malı yayılım etkisi görülmektedir. Yani, vatandaş sadece yaşadığı bölgede bulunan kamu malından değil, aynı zamanda komşu bölgenin kamu malı seviyesinden de fayda almaktadır.

Merkezi hükümet, bir transfer kuralı uygulayarak transfer miktarlarına karar vereceğini duyurur ve kurala ilişkin parametre değerlerini açıklar. Daha sonra, yerel hükümet, maliye politikası değişkenlerini belirler. Maliye politikası değişkenleri herkes tarafından gözlemlenebildikten sonra vatandaşlar kendi optimizasyon problemini çözer. Literatürde ekonomideki bu üç ajan arasındaki etkileşimi gösteren bir model bulunmamaktadır. Bu çalışma bu eksikliği doldurmayı amaçlamaktadır. Söz konusu Stackelberg tipi model yapısı zaman tutarlı sonuçlar vermektedir.

Bu çalışmada, modelin karışıklığını bir miktar azaltabilmek için bazı varsayımlar yapılmıştır. Bunlardan en önemlisi yerel hükümetlerin simetrik yapıya sahip olmasıdır. Bu varsayımın kaldırılması ya da yumuşatılması farklı şekilde gözlemlenebilir, Mesela, gelir seviyesi açısından iki farklı bölgenin oluşturulması, farklı tarzda soruların cevaplanmasına neden olabilecektir. Fakir bölge ve zengin bölge arasında yürütülecek transfer kuralı, hangi bölge açısından kazançlı veya hangi bölge açısından hangi transfer kuralı özelliği refah yükseltici etki yaratabilir gibi sorulara cevap verebilecektir.

APPENDIX C

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Cevik, Zeynep Burcu

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EDUCATION

Degree	Institution	Year of Graduation
PhD	METU, Economics	2016
MS	Bilkent University, Economics	2009
BS	METU, Mathematics	2006
Minor Program	METU, Statistics	2006
High School	Mamak Anadolu High School, Ankara	2002

RESEARCH & WORK EXPERIENCE

Year	Place	Enrollment
2011- Present	METU, Department of Economics, Ankara	Teaching and Research Assistant
2013-2014	University of Pennsylvania, Philadelphia, USA	Visiting Scholar
2010-2011	Vakifbank, Economic Research Department, Ankara	Economist
2007-2010	Vakifbank, Economic Research Department, Ankara	Researcher
2006-2009	Bilkent University, Department of Economics	Teaching Assistant

FOREIGN LANGUAGES

Advanced English, Intermediate French

PUBLICATIONS

1. Fiscal Efficiency, Redistribution and Welfare” (with Bilin Neyapti), *Economic Modelling*, Volume 41, August 2014, Pages 375-382
2. “Does Fiscal Decentralization Promote Fiscal Discipline?” (with Bilin Neyapti and Zafer Akin), *Emerging Markets, Finance and Trade*, 2016, Volume 52, Issue 3, Pages 690-705

FELLOWSHIPS AND SUCCESS:

Year	Fellowship or Success
2013-2014	TUBITAK Scholarship for research abroad
2008-2010	TUBITAK Scholarship for a project with Bilin Neyapti
2006-2009	Bilkent University, Economics Department -Tuition paid scholarship
1995-2002	Graduated from Mamak Anadolu High Schol as a first degree

APPENDIX D

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü	<input type="checkbox"/>
Sosyal Bilimler Enstitüsü	<input checked="" type="checkbox"/>
Uygulamalı Matematik Enstitüsü	<input type="checkbox"/>
Enformatik Enstitüsü	<input type="checkbox"/>
Deniz Bilimleri Enstitüsü	<input type="checkbox"/>

YAZARIN

Soyadı : Çevik
Adı : Zeynep Burcu
Bölümü : İktisat

TEZİN ADI (İngilizce) : Welfare Effects of Intergovernmental Transfers:
Equity versus Efficiency

TEZİN TÜRÜ : Yüksek Lisans Doktora

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir.
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir.
3. Tezimden bir bir (1) yıl süreyle fotokopi alınmaz.

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: