

The Pennsylvania State University  
The Graduate School  
School of Public Affairs

**CENTRAL AND LOCAL GOVERNMENTAL FISCAL BEHAVIOR  
UNDER FISCAL FEDERALISM—AN ANALYSIS WITH ASYMMETRIC  
SETTING**

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by  
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# Abstract

How central government and subnational government share funding and administrative responsibilities has always been a topical and difficult issue for most sovereign states in public administration and public finance area. Introduced by the German-born American economist Musgrave [1], fiscal federalism has been massively investigated as a general framework to deal with the issue of funding and responsibilities in both the unitary and federal systems. The field of fiscal federalism studies how to divide responsibilities (including finances) between central and subnational governments to supply public goods and services with economic efficiency and achieve various public policy objectives. Determining the optimal division of responsibilities is difficult because of varying subjective views about what the role of government should be. As a result, fiscal federalism research generally renders no judgment on the proper level of total government intervention or what types of services governments should provide. The research focuses instead on how responsibilities are assigned across multiple layers of government once policymakers have decided to implement a given policy, and what trade-offs may be involved in administering it.

In this paper, I analyzed the framework of fiscal federalism by separately investigating four questions in terms of both central and subnational level governments. By analyzing the theoretical design and practical situation, I generate a overall understanding about the general fiscal federalism setting, explained the gap between theoretical design and actual administration process theoretically and empirically tested if the theoretical inference is reliable. TO be more specific, by comparatively analyzing the fiscal structure design and administrative reality in United States and China, I investigated the role of political intention in causing the difference, and explained theoretically why the administrative reality and theoretical design are different in both countries under the asymmetric setting using game theory tools. Besides, I also did some empirical test to statistically support some of the theoretical inference.

Key words: fiscal federalism, asymmetric game theory analysis, comparative study

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# List of Symbols

## Benchmark Model for Flypaper Effect

- $X$  private good, p. 36
- $X$  public good, p. 36
- $y$  representative resident's income, p. 36
- $\tau$  lump-sum tax, p. 36
- $f$  non-matching intergovernmental transfer, p. 36
- $\alpha$  preference on public and private goods of representative resident , p. 36
- $\lambda_{rc}$  lagrange multiplier for representative citizen, p. 36
- $\lambda_e$  lagrange multiplier for the economy, p. 37
- $\lambda_{lg}$  lagrange multiplier for the local governemnt, p. 37

## Model for Flypaper Effect with Matching Grants

- $m$  the matching ration of intergovernmental transfer, p. 37
- $f_m$  matching grants, p. 37

## Model for Flypaper Effect with Distortionary Tax

- $X_t$  Private taxable goods, p. 42
- $X_{nt}$  Private non-taxable goods, p. 42
- $\theta$  tax rate on  $X_t$ , p. 42

# Acknowledgments

# **Chapter 1**

## **Introduction**

### **1.1 About Fiscal Federalism**

Most countries, even if they are not explicitly federal system in terms of political structure, have to grapple with issues relating to hierarchical structure of governments. The fact of the hierarchical governments implies that there is an unequal distribution of political and economic powers. A distinguishing feature of a fiscal federalism is the likely misalignment of expenditure responsibilities and revenue assignments. The field of fiscal federalism studies how to divide responsibilities (including finances) among federal, state, and local governments to improve economic efficiency and achieve various public policy objectives. Determining the optimal division of responsibilities and funding is difficult because of varying subjective views about what the role of government should be. As a result, fiscal federalism research generally renders no judgment on the proper level of total government intervention or what types of services governments should provide. The research focuses instead on how responsibilities are assigned across multiple layers of government once policymakers have decided to implement a given policy, and what trade-offs may be involved in administering it. To be more specific, Central and local governments have their own way to generate revenue and supply public goods and services separately. Besides, central government compensate the low income subnational government by doing transfer payments, which is so called intergovernmental transfer, so local governments especially the low-income local government still got the ability to supply the necessary public goods and services. To summarize, central and local governments got the ability to collect the revenue so to supply the necessary public goods and services with the consideration to achieve the political intention. Depend on the general fiscal federalism setting, I'll give an overall view of the fiscal federalism structure in the rest of this chapter. Three key points are vital for the understanding: the

revenue source for different levels of government, the public service responsibilities, and the financial connection between central and subnational governments, as is shown in Figure 1.1

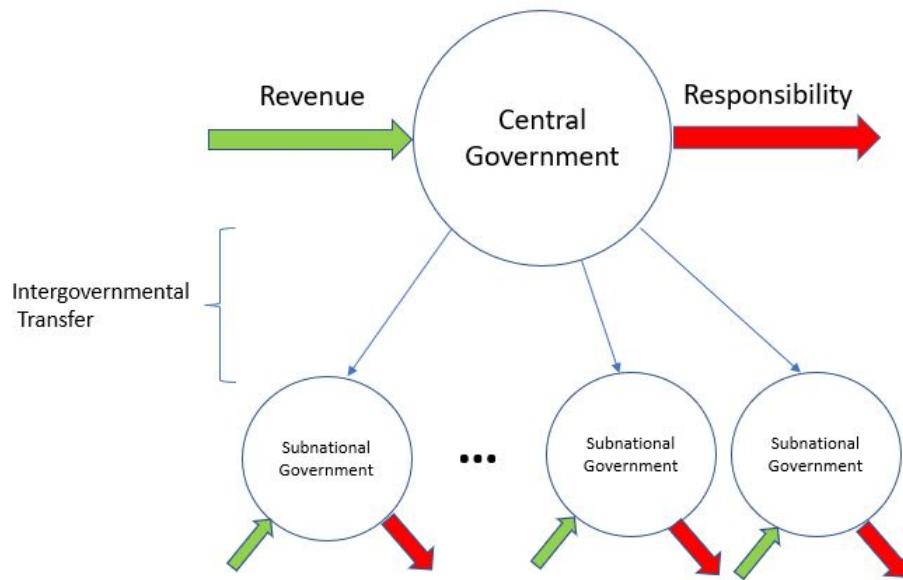


Figure 1.1: Fiscal Federalism Structure

For the following part of this chapter, I'll give a basic introduction about the fiscal federalism structure in USA, to be more specific, I'll describe the revenue and responsibilities of different levels of governments, and the intergovernmental transfer between different levels of governments.

### **1.1.1 Fiscal Federalism Structure in America**

#### **1.1.1.1 Revenue and Responsibilities of different levels governments**

The United States constitution stipulated that states keep the remaining rights, which means except for the clear defined rights that federal government have, states government keep the undefined rights. Besides, the constitution set no instruction about the responsibilities between state and local governments. This feature combined with the fact that America is a huge country with rich diversity lead to an interesting administrative fact:

the responsibilities of state governments in each states are not identical. Within each states, the local governments form up their responsibilities based on the actual needs, thus the local governments are not identical neither. Thus the follow introduction are not describing the administrative reality precisely, but are introducing the general structure.

Under current fiscal federalism system in America, federal, state and local governments rely on different source of income, have different function in supplying the public good and federal government reimburse the state and local government through intergovernmental transfer. On revenue side, from the breakdown of the source of revenue of fiscal year 2019, 50% of the federal revenue comes from the individual income tax, 7% from corporate income tax, 36% is social insurance or payroll tax. On the other hand, on state and local level, intergovernmental transfer accounts for more than 30 percent on average, followed by sales taxes and property tax.

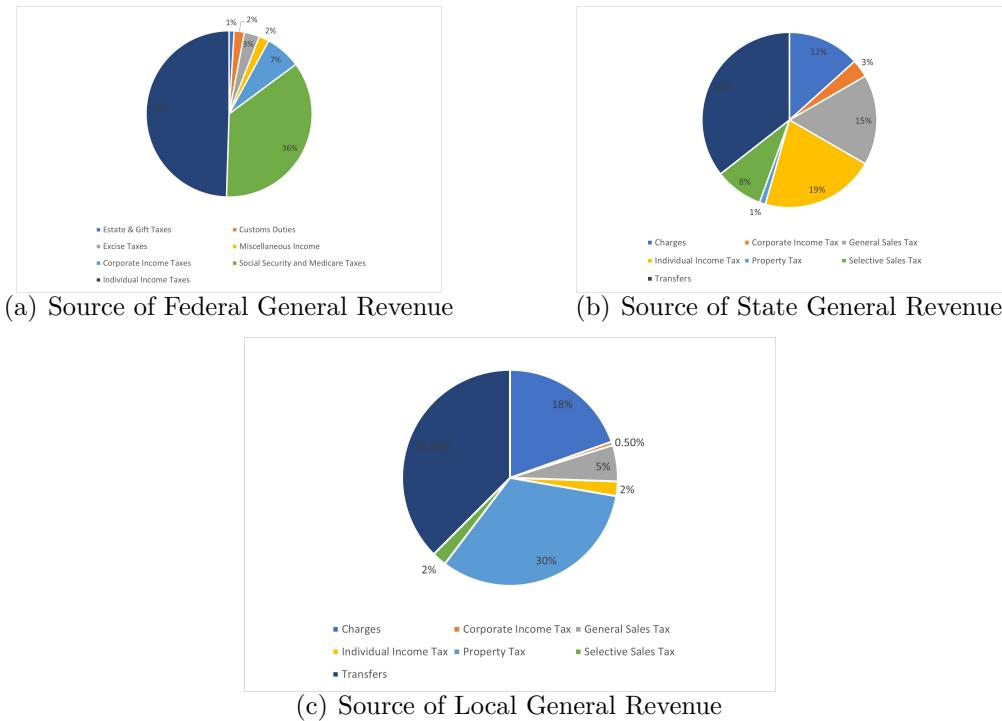


Figure 1.2: Source of Revenue for Multiple Level of Governments. Data Source: The Department of the Treasury and the Bureau of the Fiscal Service

On the expenditure side, federal, state and local government functions differently in supplying public goods and services. Filtered out the public-goods-unrelated expenditure such as interest from debt, federal government is paying for income security, social security, health, national defense, highways and infrastructure, medic care, social services such as

education, training and employment. Similarly, if filtered out the expenditure which are unrelated to the public goods and services in state and local governments, the left parts include public welfare, elementary and secondary education, higher education, health and hospitals, highways and roads, police, courts, housing and community development.

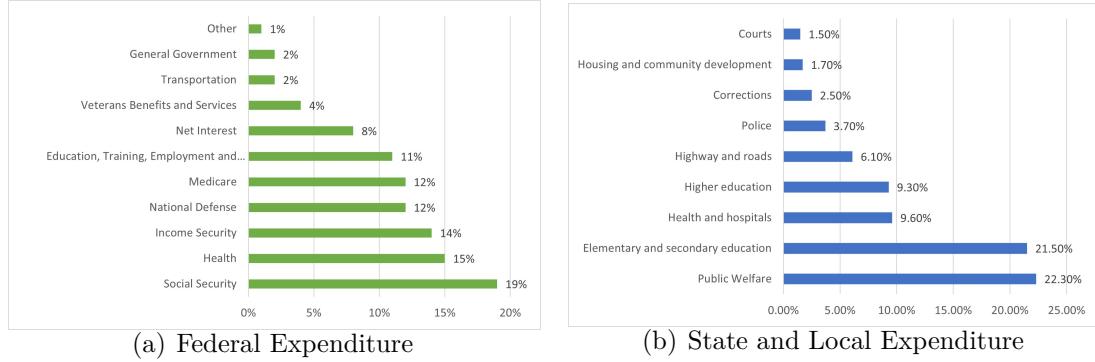


Figure 1.3: Source of Revenue for Multiple Level of Governments. Data Source: The Department of the Treasury and the Bureau of the Fiscal Service

Though The revenue and expenditure structure of federal, state and local government are relatively stable. Figure1.3 shows a cross-sectional data of 2019. A time series fluctuation is presented in FigureA.1 attached in Appendix A. Information in FigureA.1 shows that it's not a big deal to capture the revenue structure by just breakdown the data in one year.

Federal, state and local government has their unique function in supplying public goods, for example, the federal government is supplying national defense exclusively, while state and local government is the sole supplier in police, courts, housing and community development. Meanwhile, some of the areas are overlapped by both layers of governments, such as public welfare, education, health, highway and infrastructure construction.

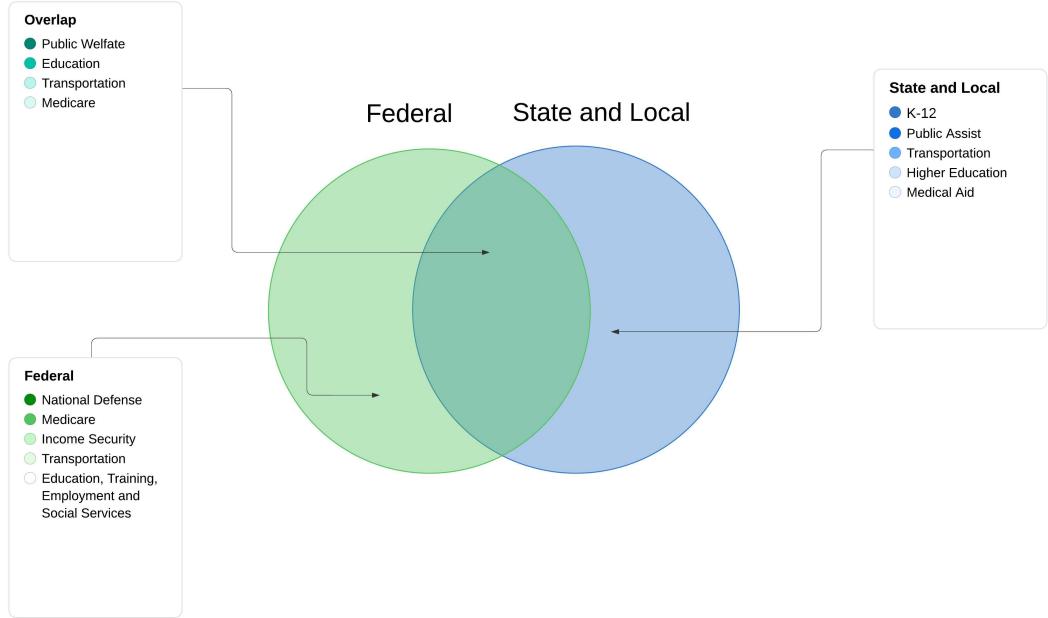


Figure 1.4: Venn graph on public goods and services supplying by federal, states and local government

### 1.1.1.2 Intergovernmental Transfer in America

In the US fiscal federal system, the Federal government imposes significant influence on state and local fiscal decision making through various grants-in-aids programs (GIA) or intergovernmental transfer(IGT). Annually, these programs amounts to nearly \$700 billion, or close to 20 percent of overall federal revenues [2]. Grounded in fiscal federalism, these programs, are guided by the idea that the allocation of publicly funded goods and services should be the responsibility of state and local governments, due to their closer proximity to the constituents. The sought for advantages of such division include: reduced costs associated with planning and administration, the ability to account for spatial differences, and increased opportunities for citizens to influence political decision-making [3]. IGT from federal government help to narrow the gap between revenue and expenditure of state and local government, encourage the supply of specific public goods and promote the horizontal equity among states

Generally, grants-in-aids programs in the US federal fiscal system, can be categorized across two dimensions including the level of restrictions that are attached to the awards, and the administrative procedures that govern the award process. In terms of restrictions,

IGT can be organized into categorical grants, block grants and general revenue sharing grants. Categorical grants include formula categorical grants, open-ended reimbursement categorical grants and project categorical grants. Project categorical grants are awarded with relatively strict set of activities that are attached to a specific purpose. Block grants are awarded to fund specific programs, but carry relatively few restrictions. The main difference is that block grants do not attach a specific purpose to how recipients spend the award. General revenue sharing grants carries the least amount of restrictions. In brief, these awards can be spent for any purpose, as long as it is not prohibited by federal or state law. According to the Congressional Research Service report [2], there are about 600 grant-in-aid programs, and categorical grants account for about 95 percent of the programs and more than 80 percent of total grant outlays.

Table 1.1: Divide Grants by level of Restriction Attached

Level of Restriction		
Low Restriction	Medium Restriction	High Restriction
Formula Categorical Grant	Block Grant	Project Categorical Grant
Open-ended Reimbursement		
General Revenue Sharing		

In terms of the administrative procedures that govern the awards, the grants can be categorized into three categories including projects grants or competitive grants, formula grants/formula-project grants, and Reimbursement grants. For competitive grants, states should apply by submitting a request and get the grants through a competitive process. They are intended to improve the efficiency of funding allocation by encouraging grantees to seek funds for well-planned and exemplary projects. Formula grants are distributed to states through mathematical formulas decided by social characters within the jurisdiction. Typically the factors in the formula depends on the intention of the grants, and common factors may include population, poverty level, income per capita, unemployment rate, enrollment in public schools, etc. Finally, reimbursement grants awards state and local governments in the form of a reimbursement for a specific percentage of state and local spending on a program. The reimbursement amount does not carry a specific limit. Reimbursement grants could be divided into open and closed ended reimbursement grants. The matching mechanism in reimbursement grants is a very intriguing consideration in public economic literature when evaluating the distortion effect. For matching grants,

federal governments will reimburse a specific ratio for each 1 dollar of state and local expenditure. Based on whether federal government set a cap on the matching grants, matching grants can be divided into open-ended matching grants and closed-ended grants.

Table 1.2: Divide Grants by Form of Administrative Procedure

Form of Administrative Procedure		
Submitting Request	By Formula	Reimbursement
Competitive Grants	Formula grants Formula-project grants	Project Categorical Grant

### 1.1.2 Introduction of the Structure in the Following Chapters

The goal of this paper is to systematically describe the fiscal federalism structure, explain some of the fiscal phenomenon in the administrative process on the theoretical level using some game theory tool and empirically test the theory I brought up, especially in America. I form the paper by asking and trying to answer a series of questions. The general questions in this research can be divided into theoretical questions and practical questions. Theoretical questions are asking what an ideal framework should be, and practical questions are asking what the actual situation is and I will try to explain the gap between the theoretical design and actual administrative reality. Besides, at least two layers of governments exists in fiscal federalism structure, so by asking theoretical questions and practical questions in two layers of government, I can generate a  $2 \times 2$  table shown in Table 1.3.

Table 1.3: General Setting of the Questions in Fiscal Federalism Analysis

	Layers of Governments	
	Central	Local
Theoretical Questions (ought)	1.What an ideal fiscal structural should be?	2.What is the optimal reaction for the fiscal policy from central government?
Practical Questions (is)	3. What is the actual decision making process in the central government?	4.What is the effect of fiscal policy on local government?

Questions about central government, which are questions on the left side in Table 1.3 will be investigated in chapter 2, in which I will talk about how to evaluate a revenue and

responsibilities combination under a fiscal federalism setting, how a intergovernmental transfer decision is made. Questions about local government on the right side are included in chapter 3, in which I'll talk about the reaction of local government when they receive the intergovernmental transfer. Besides, in chapter 3, I'll try to explain subnational governments' behavior using some game theory tool under the asymmetric setting. In chapter 4, I'll try to find some empirical evidence of the theory inference I generated in chapter 3.

# **Chapter 2 | Questions on the Central Level**

Fiscal federalism is one typical form of fiscal decentralized structure. One consensus among economist and public administrative researchers is that decentralized fiscal structure is obviously more efficient in public goods and services supplying especially in those large and complex country with multiple level of administrative institutions. Hayek [4] states that the local government has significant advantages in knowing the information and supply proper kinds and amounts of public goods and services. Hayek's points is the starting points of the research in the advantage of fiscal federalism. Stiliger [5] followed Hayek's understanding and analyzed the necessity of intermediate and local government especially the necessity of protect the funding ability of those subnational governments. Tiebout [6] proved theoretically that voting on feat mechanism could promise the matching between public goods supply and needs. Besides, by introducing the competition rule of local governments into public area, Tiebout also proved that the decentralized structure is a promising tool in improving the administrative efficiency. Tiebout's theory seems get supported by the actual data showed in Table 2.1, which potentially reflects the difference of tax burden preference of different states. So for the following part, I'll only talk about the evaluation of decentralized fiscal structure, to be more specific, fiscal federalism.

Table 2.1: Effective Tax Revenue in America

State	State and Local Taxes (\$ billions)	Personal Income (\$ billions)	Effective Tax Rate
New York	177.8	1,281.10	13.90%
District of Columbia	7.5	55.5	13.40%
North Dakota	5	39.5	12.70%
Hawaii	9.5	75.4	12.60%
Vermont	3.8	32.6	11.70%
United States Total	1,652.80	16,820.30	9.80%
Alabama	16.4	198.9	8.30%
Oklahoma	13.9	174.4	8.00%

*Source: U.S. Census Bureau Dataset*

## 2.1 How to Evaluate the Fiscal Federalism System

Even within the topic of fiscal federalism, the fiscal federalism structures in different countries have different content and features, needless to say, they show different impact in public goods and services supplying. Like I mentioned in Chapter 1, it's hard and nearly impossible to find a perfect stick yard criterion to compare fiscal federalism in different countries. I'll try to explain and get a comprehensive way to evaluate fiscal federalism. Literature about fiscal federalism can be roughly divided into two groups. First-generation theory of fiscal federalism concentrate on the fiscal structure itself, focusing on the efficiency of federalism in collecting revenue and offering responsibilities, and whether the revenue-responsibility combination perform well in public goods supply. Coming to second-generation theory of fiscal federalism, scholars get interested in the effect of fiscal federalism on other area such as the effect on economic development.

### 2.1.1 First-Generation Theory of Fiscal Federalism

One popular aspect to estimate if the fiscal structure is reasonable is to evaluate the fiscal structure economically. In another word, to estimate if the combination of funding and responsibilities meet Pareto efficiency, which happens when resources are so allocated that it is not possible to make anyone better off without making someone else worse

off [7]. This is also the most common understanding wildly accepted by both economic and public administrative researcher. Under economic view, three directions are helpful in estimating the fiscal structure, including externality, information complexity and incentive compatibility. Firstly, about externality, an ideal setting is to initialize the externality as much as possible for both positive and negative externality. Oates' [8] work on fiscal federalism is a milestone for modern fiscal federalism research, one principle he mentioned in his work is that government and the residents living in the jurisdiction should pay for their negative externality and get paid for positive externality. Olson [9] states that the "free rider" issue could be overcome by making the jurisdiction and the beneficiary area identical, besides, the equilibrium under this setting could make marginal cost equal to marginal benefits. The externality evaluation is obviously an efficiency consideration. One example of efficiency consideration in America's fiscal federalism setting is the revenue structure related to individual tax. As is shown in Table 2.2, for the tax object that are convenient to move freely, such as individuals, individual income tax is mainly collected by federal governments and state governments to minimize the behavior distortion and improve efficiency. Since in that way, individuals are indifferent to where they live and where to pay their tax.

Table 2.2: . Percentage Composition of Tax Revenue by Government Level

Type	Federal	State	Local
Individual income	51.80%	37.20%	4.70%
Corporate income	6.90%	4.70%	1.10%
Other taxes	41.20%	58.10%	94.20%

Secondly, information complexity in administration process is also a important consideration in evaluating the fiscal federalism structure. Except for the earlier job represented by Hayek and Tiebout, Basley et al [10] set up a political economy model to simulate the decision making process in a democratic country, in their model they introduced insensitivity of central government into their model and emphasized the advantage of local government in public goods supplying. Besides, the information communication is mutual. For one, local governments know local residents' needs better, besides, local governments' behavior could be better perceived by local residents. Dethier [11] mentioned that the decentralized structure of fiscal federalism put the local government under supervision. Based on Dethier's idea and Tiebout's voting on feet framework, Baicker [12] set up a horizontal competition structure, he introduced multiple local governments and states that under yardstick competition framework, decentralized fiscal structure will help local

residents get a direct evaluation about local governments' efficiency in public goods supply, thus help them easier to "vote on feet". Local governments should get pushed by this information transparency.

Finally, a good fiscal structure should have incentive compatibility. Incentive compatibility is a game theory analysis tool introduced by Leonid Hurwicz [13] wildly used by business management area at first. A mechanism is called incentive-compatible (IC) if every participant can achieve the best outcome to themselves just by acting according to their true preferences. Incentive compatibility was introduced into public administration and public economics area and became an important criterion to evaluate the quality of fiscal federalism. Local governments could be motivated to supply proper amount and quantity public goods with efficiency under proper fiscal federalism setting. Eckstein [14] points out that the proper combination between funding resource and responsibilities could be a great motivation for any kinds of organizations. Under Eckstein's setting, at least in democratic country, working hard with efficiency in public goods supplying is a weakly dominate strategy since that will attract more residents and increase more public funding resource. Another clue is that for most of the scholars, when they investigate the related topic and talk about governmental fiscal behavior, while the central government's goal is hard to define, by default they just assume the local government's target is to maximize the local fiscal revenue(Baretti, Bucovetsky,Dahlby,Jha) [15–18].

The main theme of the first-generation theory of fiscal federalism is to approve the positive effect of this decentralized structure, confirm the positive effect in public goods supplying. The main investigation is to evaluate the role of fiscal federalism in the public goods efficiency. Most of literature in this period is theoretical investigation.

### **2.1.2 Second-Generation Theory of Fiscal Federalism**

When it comes to the second-generation theories, scholars do not merely stare at the efficiency of fiscal federalism in public goods supplying. For further step, they start to notice the relationship between fiscal federalism and other social area, such as economic development [19, 20], local government behavior [21], etc. One obvious change is that, second-generation theory researchers, though still admit the fundamental effect that fiscal federalism played in public goods supply, start to emphasize that fiscal federalism may not always work perfectly especially in developing countries [22–25]. I summarized the second-generation fiscal federalism literature and divide all these literatures into three categories, which are relationships with economic development, political intention, and effect on local governmental fiscal behavior.

The investigation about the relationship between fiscal federalism and economic development also inspired by Charls Tiebout [6]. Though Tiebout's theory has been supported by huge amounts of econometric evidence, his theory is obviously inspired by American fiscal structure. Most of the assumptions in Tiebout's setting are hard to achieve especially in developing countries. Since Tiebout just assume local governments have the ability to supply public goods with proper efficiency. Based on that assumption, he answered how to match the preference from the residents with the ability of the local government. Some second-generation theory literatures tried to open the black-box in Tiebout's assumptions. Some researchers noticed the role of production factors in fiscal federalism setting. A lot of econometric evidence that even in developed countries such as european union, the residents within one country are not moving totally freely, needless to say the movement across different countries [26]. Even for the residents who moved across different jurisdiction, the performance in public goods supply is not their main concern according to Faguet's servey [27]. Except for the population movement, capital is also a interesting factor in fiscal federalism. Mckinnon [28] attribute the economic boost in southern United States to the low factor cost including capital, labor and land. He then did a follow up research claims that the compensation and equalization effect of transfer payment in fiscal federalism system may block the flow of production factors. Cai and Treisman [19] proved that with initial difference in resource endowment, the decentralized feature of fiscal federalism may lead to local governments' sturdiness in economic development since the moving of capital seems surely lead to development imbalance, the imbalance between different jurisdictions will destroy the enthusiasm of local governments. Based on research related to resource endowment imbalance, Treisman [23] took one step further, he emphasized that local government of the jurisdiction with low resource endowment tend to spend more on decreasing poverty instead of the target related to economic development efficiency.

Second-generation theory scholars noticed the effect of fiscal federalism on local governmental behavior, such as the effect of intergovernmental transfer on local governmental's tax collecting effort [29], the effect of intergovernmental transfer on local governments' spending structure [30], relationship between fiscal federalism and local government debt [31] etc. The effect of fiscal federalism on local governmental's behavior will be analyzed in the asymmetric setting in Chapter 3.

Except for merely economic consideration, another consideration is political intention. Though not so popular, political factor explains a lot of fiscal federalism design that can hardly be explained by economic and efficiency theory. Fiscal federalism in Canada plays

an important role in equalization across different jurisdiction, thus this fiscal system is like the glue for the political federalism, similar econometric evidence can be found in Australia [32]. However, the fiscal federalism in Italy shows a different look, the transfer payment mechanism from high fiscal revenue area to low revenue area exacerbate the conflict between different jurisdiction.

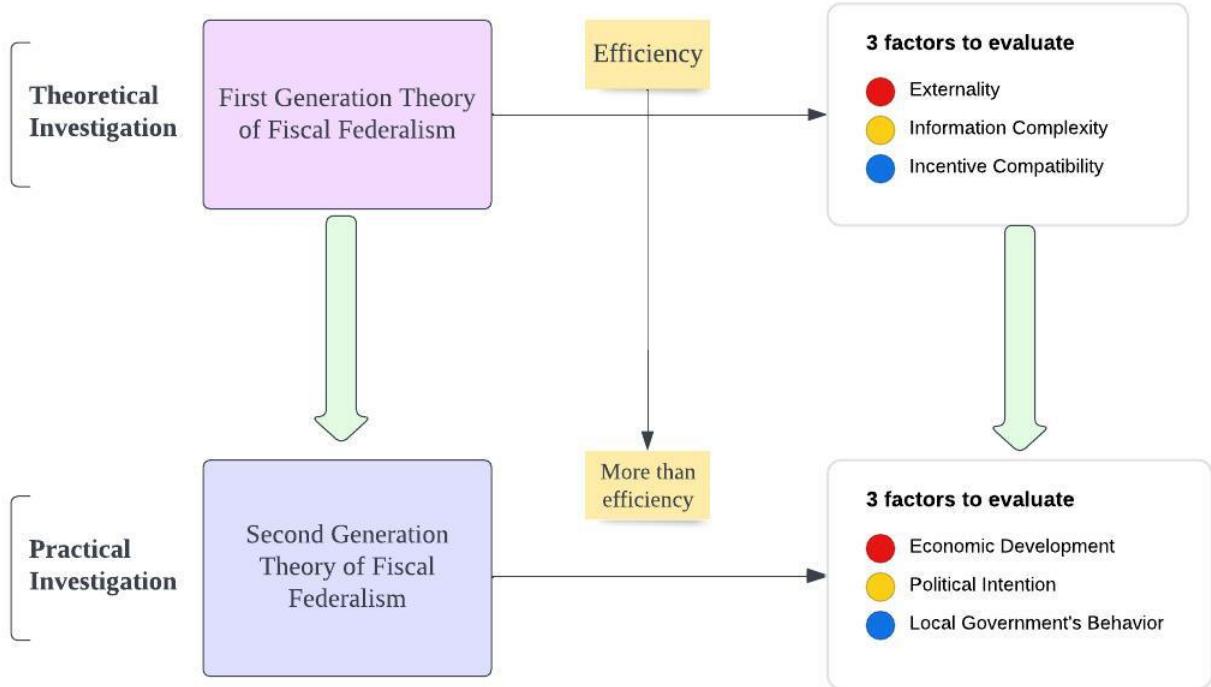


Figure 2.1: How to evaluate the fiscal federalism

To summarize, as is shown in Figure 2.1, initial research about fiscal federalism designed a theoretical ideal framework to supply public goods efficiently. In developed countries especially in America, scholars did find some empirical evidence to support the benefits of this decentralized fiscal structure. However in developing countries, the fiscal federalism didn't work out perfectly, this administrative fact inspired the second-generation theory, scholars starts to focus on the other side of the coin.

Except for the combination of revenue and responsibilities within each jurisdiction, the interaction between governments is also an intriguing topic for fiscal federalism researchers. The interaction between governments can be divided into horizontal interaction which means the interaction among same level, and vertical interaction which means interaction between central and subnational governments. I'll focus on the vertical interaction in

this paper.

## 2.2 How Intergovernmental Transfer Decision is Actually Made

### 2.2.1 Game Theory Modeling of Bargaining Process

In America, every year nearly \$700 billion, or nearly 20 percent of overall federal revenues, are allocated toward various state and local government grant programs. The mechanism of intergovernmental transfer distribution has always been an intriguing topic in the public finance area.

The grants distribution decision in democratic countries is viewed as an bargaining game within a specific decision-making group, such as a specific committee, the congress or the house, depends on which group is the decisive institution. For the bargaining models to simulate the grants distribution bargaining, four assumptions are quite important among all the necessary assumptions: recognition rule, voting rule, amendment rule and money-distribution rule. Recognition rule means how to decide who to make the proposal. In another word, the rule to choose an agenda setter. for example most of the literature assume the random recognition rule [33–36], which means  $n$  members among the decision making institution have equal probabilities to be chosen to make the initial proposal. Voting rule means the standard to judge if the proposal is passed, common voting rule include majority rule and unanimously voting rule. Amendment rule means the constraints on making amendments, ranging from the closed rule, in which no amendments are allowed, to the open rule, in which any and all (germane) amendments are allowed. Grants-type rule means how grants could be manipulated by decision making institution, for example, some scholars assume the decision making institution can directly decide the number among the receivers, which is referred as "earmarks" or "pork barrel" spending model.

Baron and Ferejohn [37] is the fundamental work for all the following bargaining model analysis. They assume random recognition, majority voting rule and earmarks rule. Baron and Ferejohn [37] and the generalization of their work by Banks and Duggan [38] show that legislators with proposal or agenda-setting power receive a disproportionate share of funding. Another feature of the equilibrium is that funds only go to legislators that vote for the proposal which is the winning coalition, with zero dollar goes outside of the winning coalition. Besides, according to their inference, when the proposal are

brought up under closed rule, the winning coalition is minimal, which means members of the winning coalition maximize their benefits.

Though pioneering in this field, in actual political environment, bare amounts of grants are similar to "earmarks", the earmarks assumptions heavily restrict the explanatory power in grants distribution. Martin [39] extends Baron and Ferejohn's model by loosen the earmark assumption. He restrains the power of members in decision making institution by only allowing them to decide the factor of the formula, not decide the number arbitrarily. As mentioned in Chapter 1, this modification in assumption is a big step to the actual political and administration life. Martin gets some different conclusions compared to Baron and Ferejohn, unlike Baron and Ferejohn's model, Martin predicts an oversized winning coalitions, and emergence of persistent winning blocs. Besides, he proved that when bargaining over a low-dimensional formula (i.e., a formula based on a small number of state characteristics), legislators have relatively little latitude in targeting funds to specific districts, this prediction is supported by some empirical evidence, Martin studied all the existing formula grants and count the number of the factors in the formula, he points out that 95% of the formula have less than 5 variables, which means members have less than 5 dimensions to bargain about, the ability to manipulate the formula is highly limited. Since members can only decide the factors among the formula, inevitably, some jurisdiction with similar features can be a free riders, even if the free riders do not belong to winning coalition, thus Martin predicts positive distribution outside the winning coalition.

### **2.2.2 Some Empirical Evidence for the Grants Distribution**

Except for the general introduction related with intergovernmental transfer in Chapter 1, a challenge with the distribution of IGT is that they take place in a political environments, where individual political agendas have the potential to influence the outcome of IGT allocations in ways that are inconsistent with the intended structure of the distribution procedures. Based on some classic game theory analysis within the congress. Given the important role of GIA in the US federal system, the influence of politics on the allocation of IGT often comes at a high cost. There is plenty of anecdotal examples that illustrates the potential costs, including Robert Carlyle Byrd's spending two decades of his career directing as much federal spending as possible to his home state, saying he wanted to be "West Virginia's billion-dollar industry".

In Markusen, Saxenian and Weiss's [40] descriptive study, they define three distinctive swings in the distribution of federal grants to cities in the 1960s and 1970s during

which federal grants grew by a tremendous amount and northeastern and midwestern cities benefit most from 1965-1972, southern and western cities benefits most from 1972-1975, and a slight swing back in favor of the first group from 1975-1978. One possible inference in their article is that the political background may partially explained this swings. Stegarescu [41] explains that the degree of IGT decentralization is a result of population, unemployment, trade-openness, presidential regimes and electoral systems based on the test result of the panel data of 17 nations. Kasdin [42] does an empirical test and mentions that state or local government governmental network complexity is a factor influencing federal transfer amount and federal controlling extent. He finds that higher-level government tends to relinquish some control when lower governmental network is highly complicated, but the amount of the transfer is negatively related with the complexity. One possible relationship behind this relationship is that high complexity is a barrier hinder politicians to claim the political credit, thus they are less motivated to secure the fiscal revenue for their representative jurisdiction. Larcinese, Rizzo, Testa [43] tested the impact of the president on the amount of federal transfer to state government. They find that state that heavily supported the incumbent president in past presidential elections tend to receive more funds. Wallis [44] also emphasizes the political effect on the amount of intergovernmental transfer. He claims that states with the high volatility of presidential vote receive significantly more federal support based on his study on the longitudinal data of all states in the U.S. Markusen, Saxenian and Weiss [40] defined the supply side and demand side when investigating the mechanism of the IGTs decision-making process, even though they don't point out the specific factors, they emphasize that the IGTs is the result of the political, economic and social characteristics of both demand and supply side.

All these literature seems imply the political factor even some biased factor impact the intergovernmental transfer. To summarize the literature listed above, one implication is that the factor that impact the intergovernmental transfer comes from not only from the legislative decision-making institution, also from administrative branch. Another implication is that political stance of local jurisdiction seems influential in intergovernmental distribution.

## **2.3 An Empirical Investigation on IGT Distribution Mechanism**

Combined with Martin's [39] conclusion introduced in section 2.2.1 and all the literature implying the political impact mentioned above, I design and conduct an longitudinal empirical test to statistically investigate the intergovernmental transfer mechanism. Specifically, I try to solve two questions in this empirical design, for one, following Martin's inference, how much extent does states share similar characteristics so the IGT benefits goes outside of the winning coalition. Another questions I wonder is, following Markusen, Saxenian and Weiss's framework, if we got the social and economic characteristics control, how much can political factors affect the IGT. The reason I focus on the political factors is that, contradictory to what we discussed in section 2.1, the political factor seems unrelated to efficiency, thus may cause more distortion and waste of resources. Besides, examination on political factors could be important because of the sharp rise in hostility between democratic and republican parties. The potential effects of political party control may impact the IGT grants distribution significantly.

### **2.3.1 Sample and Characteristic Selection**

I focus on the direct IGT from federal government to state governments in America. To incorporate the political impact into the data framework, I did a stratified sampling to collect states sample from traditional republican states, traditional democratic states and swing states. The state grouping method are based on two criterion, the historical presidential election result and the winning rate following Beachler, Donald, Bergbower, Matthew etc.'s work [45]. The democratic states and republican states are those chose same party in the president election since 1984 with wining rate over 58%. The swing states are those have chosen president from two parties and the winning rates are less than 58%.

The states collected into my sample can be listed as Table 2.3

Table 2.3: States Sample and Grouping

States	Group	Code
Wyoming		
Idaho		
Kansas	Red States	1
Nebraska		
North Dakota		
Maryland		
Massachusetts		
Rhode Island	Blue States	2
New York State		
Washington		
Pennsylvania		
Nevada		
Wisconsin	Swing States	3
Ohio		

The social and economic characteristics that commonly included in the formula when doing the intergovernmental transfer are population, working age population weight, median household income, unemployment rate, road mileage and gdp [2]. I collected all factors mentioned in Dilger's service [2] of the sample states, besides, I also take reference from some major intergovernmental transfer programs such as Medicaid, the Title I-A education program, Temporary Assistance for Needy Families (TANF), Section 8 Housing Choice Vouchers, and the Community Development Block Grant (CDBG) to collect factors comprehensively. I also did proper operation for data regression convenience and better data visualization. The characteristics I collected and source of data can be listed as Table 2.4.

Table 2.4: Social characteristics for Sample States

Variables	Definition	Operation	Source	Time Period
gdp	Real GDP	Log transformation	FRED	2000-2019 annually collected
lgp	Population	Log transformation	Census of bureau	2000-2019 annually collected
wapw	Working age population weight	No operation	Census of bureau	2000-2019 annually collected
mhi	State median household income	Log transformation	Census of bureau	2000-2019 annually collected
ur	unemployment rate	No operation	FRED	2000-2019 annually collected
prm	public road mileage	Log transformation	Bureau of transporta- tion statistics	2000-2019 annually collected

### 2.3.2 Principle Components Analysis of Social and Economic Characteristics

As mentioned above, too many factors may exists in the formula that decides the grants distribution. What's even worse, one can distinguish the multicollinearity problem in the variables I collected just by intuition, for example, working age population weight and unemployment rate are strongly related variables, higher population is doomed to occupy more public road. To answer the first question, these two problems are obvious hinder thus it's hard to judge how similar jurisdictions could be in social and economic characteristics directly. So I conduct a primary components analysis to reduce the data dimension and overcome multicollinearity problem to check if the reduced-dimension

data are cluster distributed or scattered distributed.

According to the primary components variance analysis result, the explained variance of each primary components ratio is:

$$[9.2615e^{-01} \ 6.4621e^{-02} \ 8.1864e^{-03} \ 1.0363e^{-03} \ 4.6269e^{-05} \ 2.3309e^{-06}]$$

The first two dimensions express 93.2% of the information. The first three dimensions include 94.5% of the information. Thus I did principle components analysis by compress the data into two and three dimensions separately. By keeping these two and three principle components with most information, comparing the characteristics between jurisdictions became a possible procedure. The scatter plot after data dimension reduction is shown as Figure 2.2

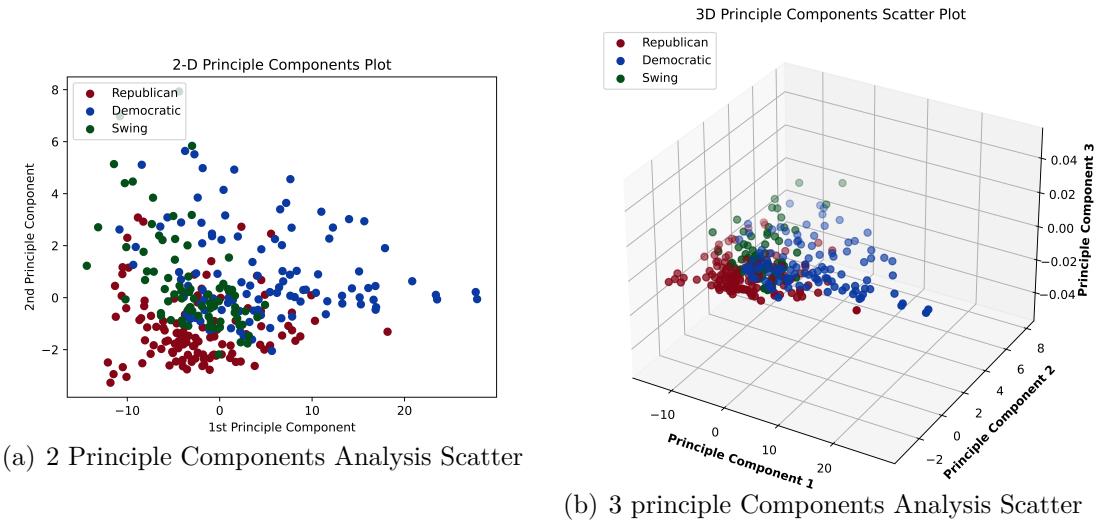


Figure 2.2: Social Characteristics Principle Components Analysis Scatter Plot

Though reduced dimensions do not have specific economic meaning, but one clear information shown in Figure 2.2 is that a lot of states characteristics are cluster distributed, which means plenty jurisdiction features in my data are quite similar. This implication is a side evidence for Martin's [39] deduction that some jurisdiction with similar features can be a free riders, this also predicts the funds outflow of the winning coalition.

Another potential implication is that, the distribution is obviously hierarchical in terms political parties. Republican states, democratic states and swing states are clearly cluster distributed in their own area. In 2d plot shown in Figure 2.2 (a) , Red dots

and blue dots distributes on two sides while swing states in the middle. This means any modification on the grants formula that benefits one party is a huge damage to another. This may explain why in the legislative bargaining process, two parties are sharply opposed and swing states are relatively indifferent. What makes Swing states different from the other parties is implied in the 3-D plot shown in Figure 2.2 (b), the green dots are not in the same level in the third dimension. This is not counterintuitive, since traditional republican states are highly likely to share similar social characteristics, but this figure may offer a different view on any fiscal collective behavior of the party. When a member in the bargaining process take any behavior, are they doing that due to their political status or arguing benefits for their represented jurisdiction? It seems that any collective political behavior within a party should find a micro-foundation. In other words, when analyze the motivation, one should focus on the motivation of particular member rather than the motivation of a whole group.

### 2.3.3 Political Impact Investigation

The goal of this section is to develop and test a theoretical framework that seeks to further advance the understanding of how the above factor outside of the bargaining institution can affect the spatial distribution of IGT. I still focus on the intergovernmental transfer from federal to state governments. Toward this end, based on the literature implication I collected in section 2.2.1 and 2.2.2, I explore how combination of political party control across legislative and administrative branches affects the distribution of IGT. The factor I'm interested includes whether legislative and administrative branches are unified, whether Democratic or Republican party has different preferences, and whether party control is aligned across the federal and state governments. The distribution of IGT is affected by (1) political party distribution across the federal and state government, and by (2) political party affiliation (i.e., Republican or Democratic party). I also examine how the perceived importance of a state in the federal political process affects the distribution of IGT. In addition, to gain insight into the role of swing state, I also examine the relationship between the IGT and whether a particular state is considered a battle ground state.

#### 2.3.3.1 Variable and Data

The variables I collected can be listed as Table 2.5, the data is annually collected from 20000 to 2019, and the source of the data and other detail is attached in Appendix

TableA.1.

One variable I need to explain here is the dummy variable  $c$ , which represents the party distribution combination in administrative and legislative branch across federal and state levels.

Table 2.5: Variables and Operation

Variables		Definition	Operation
Dependent Variable	lg(igt)	IGT from federal to state i	Log
Independent Variables	c	Combinations of levels, branches and parties.	No operation
	p	Dummies to identify i is democratic, republican or swing.	
	log(gdp)	Real GDP	
	log(pl)	Population	
Control Variables	wapw	Working age population weight	Log
	mhi	State median household income	
	ur	unemployment rate	No operation
	prm	public road mileage	Log

Three aspects decide the type of " $c$ ", which are the governmental level, branches and different parties. 2 Branches and 2 levels formulate a  $2 \times 2$  Table shown in Table 2.6, which are four sectors. For each sector,  $u_1, u_2, s_1, s_2$ , two possible parties may get control, which are the democratic party " $d$ " and the republican party " $r$ ". For example,  $c_1 = (u_1 = r, u_2 = r, s_1 = r, s_2 = r)$ , where 'r' means republican party and 'd' means democratic party. Here, I just use abbreviation  $(r, r, r, r)$  to express  $c_1$ , which means combination one. In this research, I use the majority of the House of Representatives to define the partyism of the legislative branch since the House plays a leading role in the budget making process. The partyism of the administrative branch is decided by the partyism of the administrative leader, which could be the president or governor. There are 16 types of combination, which are:

$$(r, r, r, r), (r, r, r, d), (r, r, d, r), (r, r, d, d), (r, d, r, r), (r, d, r, d), (r, d, d, r), (r, d, d, d)$$

$(d, r, r, r), (d, r, r, d), (d, r, d, r), (d, r, d, d), (d, d, r, r), (d, d, r, d), (d, d, d, r), (d, d, d, d)$

I use  $c_1, c_2, \dots, c_{16}$  to express these 16 different combinations. In the regression, only fifteen combinations are saved, the first combination  $c_1 = (r, r, r, r)$  is omitted in regression to avoid the multicollinear problem and  $c_1$  acts as a benchmark.

Table 2.6: Branches and Levels Combination

Branches		
	administrative	house
Levels	federal	$u_1$
state level		$s_1$
		$s_2$

As for dummy variable  $p$ , I collected the longitudinal data of three different types of states based on whether the states are traditional democratic states, republic states, or swing states, Fifteen states are divided into 3 groups. The first group is the traditional republican states group, or what are called "red wall states", and we code  $p = 1$  for the first group. Second group is traditional democratic state group, also known as "blue wall states", and we define  $p = 2$  for second group. The third group is the swing state group, also known as the "battle ground states",  $p = 3$  for the third group. The sample states in this research is same as the sample in principle components analysis collected in Table 2.3.

I selected some variables and generate some relationship scatter plots to get a intuitive description about the relationship. The figure is shown in Figure 2.3. I hide the legend of different party. One thing that should be noticed is that, except for the lower left subfigure, which shows the relationship between relationship and igt, shows a clear linear trend, other figures show obvious hierarchical distribution. The linear relationship between population and intergovernmental transfer amount is not surprising, but the hierarchical plot is kind of intriguing, hold x axis constant, we still get different igt amounts. Even for the relationship between the partisan of states and IGT amounts, especially for those democratic states, the points falls on both upper and lower sides. The hierarchical distribution implies that the social and economic characteristics cannot fully explains the IGT distribution, and the rest of the black box may potentially be explained by political impact and the influence out of the legislative branch.



Figure 2.3: Factor and IGT Scatter Plot

### 2.3.3.2 Model Setting

Though I did a relatively comprehensive literature investigation in grants distribution formula issue, and the sample data includes the most important concerns in intergovernmental transfer distribution, it still possible that some variables may be omitted from the equation, especially given this is a longitudinal data with 19 years time span. So one crucial problem for this investigation is how to deal with the potential omitted variable issue and avoid the following heteroscedasticity and endogeneity problem. To make sure I can get an unbiased estimate, I adopt two factor fixed effect model in the regression. In the following research, I display 3 regression models. The benchmark model is OLS regression. Besides, since the fiscal behavior happens on state level, which is a relatively big and stable jurisdiction, it's totally possible some factors are time-invariant. So, the second model in my display is fixed model with time variable fixed. Though, state is a relatively stable jurisdiction, the time span is relatively long, thus some omitted variables

could be time-variant as well. To get all these omitted variables controlled as much as possible, the third model I adopt is two factor fixed effect model, with both time factor and individual effect controlled.

The equation for OLS regression can be displayed as follow.

$$\begin{aligned} \log(igt_{i,t}) = & \alpha + \beta_1 c_{i,t} + \beta_2 p_{i,t} + \beta_3 \log(gdp) + \beta_4 \log(pl) + \beta_5 \log(mhi_{i,t}) \\ & + \beta_6 wapw_{i,t} + \beta_7 ur_{i,t} + \beta_8 \log(prm_{i,t}) + \epsilon_{i,t} \end{aligned} \quad (2.1)$$

For  $t = 1, 2, 3 \dots T$  and  $i = 1, 2, 3 \dots N$

The second model, which is the fixed effect model with time effect fixed is:

$$\begin{aligned} \log(igt_{i,t}) = & \alpha_i + \beta_1 c_{i,t} + \beta_2 p_{i,t} + \beta_3 \log(gdp) + \beta_4 \log(pl) + \beta_5 \log(mhi_{i,t}) \\ & + \beta_6 wapw_{i,t} + \beta_7 ur_{i,t} + \beta_8 \log(prm_{i,t}) + \epsilon_{i,t} \end{aligned} \quad (2.2)$$

For  $t = 1, 2, 3 \dots T$  and  $i = 1, 2, 3 \dots N$

Finally, the third model, which is two factor fixed effect model with time effect and individual effect controlled is:

$$\begin{aligned} \log(igt_{i,t}) = & \alpha_i + \theta_t + \beta_1 c_{i,t} + \beta_2 p_{i,t} + \beta_3 \log(gdp) + \beta_4 \log(pl) + \beta_5 \log(mhi_{i,t}) \\ & + \beta_6 wapw_{i,t} + \beta_7 ur_{i,t} + \beta_8 \log(prm_{i,t}) + \epsilon_{i,t} \end{aligned} \quad (2.3)$$

For  $t = 1, 2, 3 \dots T$  and  $i = 1, 2, 3 \dots N$

There are four hypothesis in this investigation, which can be listed as follow.

### **Hypothesis 1–The unified Government Hypothesis**

Unified government means the administrative branch and legislative branch on federal level coming from same party. Unified government is likely to spend a higher overall spending scale since the financial powers are less limited.

### **Hypothesis 2–Party Specific Hypothesis**

Democratic and republican parties have different preferences on the IGT scale. The preference on IGT of different parties is fuzzy here, since two possible inference may be reasonable here. In terms of the scale of government, the democratic party prefers a big government, which would lead to a higher-scale IGT, and the republican party holds the opposite idea. In terms of the administrative structure, democratic government tends to establish a centralized government, whereas republican government prefers a decentralized structure. In this way, we can get a opposite conclusion

### **Hypothesis 3–Alignment Hypothesis**

The allocation of the IGT are affected by the political ideology. The federal government

is likely to allocate more IGT to states that are controlled by same party.

#### **Hypothesis 4–Battle Ground States Hypothesis**

The competition level between two parties in state would affect the IGT received by that state government. The federal government is motivated to get elected or reelected; thus, the federal government is willing to put resources and supply more public goods to states that matter a lot for their election to get political credits.

The regression results can be summarized as Table 2.7

Table 2.7: Regression Results Display

	Model-1 Log(igt)	Model-2 Log(igt)	Model-3 Log(igt)
c2	-0.0161 -0.43	-0.0534 -1.99	-0.0954 -1.83
c3	-0.0467 -1.4	-0.0352 -1.4	0.0282 -1.09
c4	0.00886 -0.19	-0.0751 -2.21	-0.101 -2.67
c5	-0.127 -3.31	-0.122 -3.12	0. -0768 -2.87
c6	0.0792 -1.33	0.0203 -0.47	0.0351 -0.73
c7	-0.0125 -0.32	0.00947 -0.27	0.0149 -0.51
c8	0.0578 -1.3	0 0	0.0767 -2.15
c9	0.0314 -1.32	0.0368 -1.21	0.00131 -0.08
c10	-0.0601 -1.27	-0.0392 -1.2	-0.0318 -0.76
c11	0.144 -1.6	0.127 -1.87	0.0973 -1.5
c12	0.0561 -1.26	0 0	0.0692 -1.94
c13	0.0963 -1.96	0.078 -1.78	0.0371 -1.07
c14	0.0653 -0.81	0.021 -0.4	-0.00931 -0.15
c15	0.000495 -0.01	-0.0173 -0.33	0.00997 -0.21
c16	0.0466 1.94	0 0	0.0512 2.44

Table 2.8: Regression Results Display (follow up)

	Model-1 Log(igt)	Model-2 Log(igt)	Model-3 Log(igt)
Democratic States	0.259	0.217	0
	-4.88	-5.51	0
Swing States	0.0899	0.0189	0
	-2.7	-1.94	0
Log(population)	0.106	1.087	0.457
	-0.92	-10.67	-1
working age population weight	-5.362	2.199	-4.768
	-6.93	-2.72	-5.43
Log(median household income)	-0.753	-1.407	-0.348
	-3.51	-8.68	-1.26
unemployment rate	0.0136	-0.0151	0.0234
	-1.97	-2.27	-4.51
Log(GDP)	0.807	-0.0855	1.346
	-6.85	-0.86	-7.43
Log(mileage)	0.143	0.0576	1.222
	-2.91	-1.59	-3.21
Constant	9.057	7.078	-1.473
	-15.21	-14.32	-0.73
Observations	309	309	309
Adjusted R2	0.942	0.969	0.68

### 2.3.3.3 Result Analysis

The first information in the display is that all three models show high adjusted  $R^2$ , especially the first two models. The high adjusted  $R^2$  could be explained by the high explanatory power in the control variables I selected. The adjusted  $R^2$  of the third model, in which both time and individual effect controlled, is relatively lower. Given that the state variable is controlled and one of the criterion of the sample selection is that the partisan of the states has not changed in the past 19 years, the deduction process in the fixed effects regression would delete the partisan variable that's the reason why coefficients of partisan variables are 0. Thus the lower adjusted  $R^2$  can be explained by

the loss of partisan variables. So for the rest of analysis, I'll adopt the coefficients of partisan variables in model 2 and all other coefficients in model 3.

From model 3,  $c_4(r, r, d, d)$ ,  $c_5(r, d, r, r)$ ,  $c_{16}(d, d, d, d)$  are statistically significant on 5% significant level. From model 2, the partisan variables, "Democratic States" and "Swing States", are significant as well. If we loosen the 5% significant level to 10%,  $c_2(r, r, r, r)$ ,  $c_{12}(d, r, d, d)$  is also significant.

The first hypothesis about the unified government is supported by the regression result. By comparing the coefficient of  $c_5(r, d, r, r)$  and  $c_1(r, r, r, r)$ , we can tell that a traditional republican state, with both administrative and legislative branch controlled by republican party, receives 7.78% lower of intergovernmental transfer under bipartisan control on federal level compared to a unified republican controlled federal. When the federal level is not uniformly controlled by the republican party, the ability to distribute grants to state level is significantly constrained.

The second hypothesis about party preference is also supported by the significant coefficients. Comparing the coefficient of  $c_{16}(d, d, d, d)$  and  $c_1(r, r, r, r)$ , I can tell that states receive 5.12% higher intergovernmental transfer when both federal and state level are controlled by democratic party compared to when both federal and state are controlled by republican party. This means that democratic party prefer to transfer more to state government, the first inference in my hypothesis dominates. The understanding of this result needs more investigation though. For example, does this conclusion still holds when it comes to the intergovernmental transfer to local level?

Alignment effect is also significant in intergovernmental transfer distribution, compared aligned combination  $c_1(r, r, r, r)$  and  $c_{16}(d, d, d, d)$ , coefficients for all other unaligned combinations, including  $c_4(r, r, d, d)$ ,  $c_5(r, d, r, r)$ ,  $c_{16}(d, d, d, d)$  are negative.

Finally, about the effect of partisan, the coefficient of swing states in model 2 doesn't support my hypothesis about battle ground state. One possible explanation is that we do not have a factor to control the effect of election period. My theoretical analysis and the supporting literature about the benefits swing states have is achieved by the election process, however this investigation is a longitudinal study with 19-years time span, thus for those years when politicians do not care about elective pressure and political credit, the benefits of swing states may be neglected.

#### **2.3.3.4 Deficiencies and Rethinking on Related Topics**

I have to admit that our investigation is limited and deficient. The most obvious defect is the time span of the data. This defect may be even more serious given that elections

happens every 2 even 4 years, not annually. One may claim that our model is not convincing since our conclusion may not hold when put our investigation in a longer time span.

Given all the deficiencies we talked about, this paper could be an extension and may get some insight in related area. The investigation on IGT is embed in the framework of fiscal federalism. Given all the benefits of fiscal federalism as Musgrave [1] mentioned, it also introduces several challenges. Our investigation may supply some implication for those challenges. For one, The involvement of multiple jurisdictions in the funding and execution of public programs introduces loss aversion behavior between the national and the subnational governments [46–48] and asymmetric information [49–51]. The former problem arises because the subnational are less accountable for the local government separation of funding and spending responsibilities. Information and potential loss aversion creates the risk that agency problems compromises the allocative efficiency of federal spending, including conflict of interest and moral hazard problems. For example, the presence of moral hazard problems act to discourage the subnational government from delivering services cost effectively [52](i.e., a shirking).

Moreover, the delegation of program implementation from a central government to a subnational government, increases information asymmetry, which may further exacerbate the above incentive problem. They may also increase the risk that agents within a subnational government engage in behaviors that are inconsistent with program goals (i.e., conflicts of interest problems). Our analysis suggests some potential explanation. Our investigation confirmed the effect of political party bias in grants distribution. This effect may be a common knowledge for both federal and state governments. Once the state government know the grants they received is guaranteed, the state government won't be motivated enough to implement the policy dedicatedly. So the incentive problem may be partly explained by the biased grants distribution process.

Finally, this research may be a supplementary material for the flypaper effect, which I will discuss in detail in the following chapter. The fly paper effect means that increase in grants-in-aid leads to significantly higher public spending than the same increase of private income, so money sticks where it hits [53]. Scholars ascribe this fact to many causes. Hamilton tried to explain fly paper effect as improper data distinction or improper empirical method [54]. Some identify flypaper effect happen due to fiscal illusion [55]. Our research may offer some new angle to understand the flypaper effect. The confirmed biased effect in grants distribution means for some of the states, getting grants from federal governments is effortless compared to getting revenue from other

methods. This relative price effect may explain the fact that state government prefer to raise funds from IGT rather than raising tax.

## **2.4 Summary**

# **Chapter 3 |**

## **Questions on the local level**

This chapter talks about the reaction of subnational governments in the interaction with central government. The most frequently investigated question is the effect of IGT. A bunch of scholars devote time and energy to analyze and evaluate the impact of intergovernmental transfers. I summarize the literature into three categories. The first category focus on the impact on local governments' spending behavior. Under the local governments' spending behavior, two directions are highly documented. First direction concentrate on the effect of intergovernmental transfer on overall spending amounts of subnational government, such as the investigation on flypaper effect. Another direction investigate the micro-segments of the local governments' spending preference. The second category talks about the impact on local governments' revenue collection behavior, such as the investigation on local governments' tax effort, debt expansion tendency and issue and soft budget constrain behavior. The third category is about the effect of intergovernmental transfer across jurisdictions, such as the role of intergovernmental transfer in equalization. This chapter gives an overview on the most innovative literature and introduced the game theory tool under asymmetric setting to generate a theoretical model. The investigation directions can be summarized as Figure 3.1.

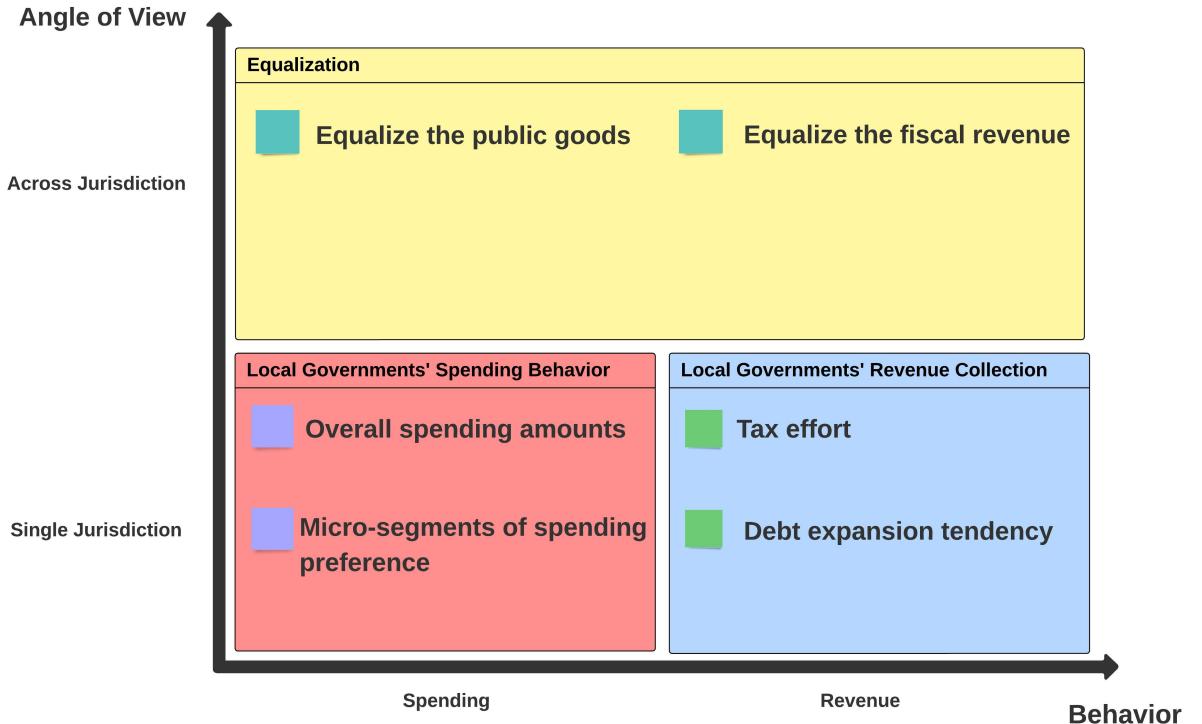


Figure 3.1: Effect of Intergovernmental Transfer

## 3.1 Effect of IGT on Local Governments' Spending

### 3.1.1 Effect of IGT on Local Governments' Total Spending Amounts

One intuitive philosophy is called "fungibility" [56], which means the intergovernmental transfer received by local government would substitute the local government's revenue. recipients assimilate federal funds into general revenue and reduce the spending on public goods through a reduction of local taxes within the jurisdiction. However, supportive empirical evidence are quite limited. On the contrary, evidence on flypaper effect is widespread everywhere.

The fly paper effect is the most influential phenomenon during the vertical transfer from government in the fiscal federalism literature is [30, 57]. According to Bradford and Oates's model, a lump sum grant from federal to state or local should be equivalent to the individual revenue increase within the jurisdiction in terms of the effect to stimulate the

public expenditure [58]. The result conclusion is latterly known as equivalence theorem. Two assumptions play fundamental role in equivalence theorem. One is median voter theorem, another one is that federal, state and local government collect tax through lump sum tax. Under this theorem, money is money. However, the empirical evidence doesn't support this theorem. More specifically, some researchers find that 1 dollar increase in personal increase would increase public expenditure by 0.02 to 0.05 dollar, while 1 dollar increase of intergovernmental transfer would trigger an increase of 0.25 to even 1 dollar in public expenditure [57, 59, 60]. This effect is known as flypaper effect. According to Inman's statistics, over 3,500 research papers investigate the flypaper effect both theoretically and empirically [53].

In this section, I'm summarizing how scholars in different stages explain the flypaper effect. The understanding of flypaper effect went through a incremental progress, though may not be chronologically. This progress can be identified as three phrases. . In the first stage, the conventional analysis, scholars believe the matching grants have both price effect and income effects while the non-matching grants is analogous to the lump-sum subsidy, which means only income effects exists. In second stage, some scholars start to realize that non-matching grants has price effects as well, but that's due to the impact of fiscal federalism setting and fiscal illusion. Federal government collecting revenue then redistributing to state and local generates fiscal illusion since this process is too complicated for consumers to perceive. In third stage, scholars start to realize the effect of distortionary tax that collect by grants recipient. The distortionary tax policy together with the low administrative efficiency in state and local leads to a higher marginal cost of the tax collection. Hence no matter the grants is matching or non-matching, the state or local government trend to use the grants rather than the tax revenue to cover the expenditure.

I set up a theoretical model and introduced the asymmetric setting into the model to explain all the local governments' reactions mentioned above. Started from a very simple Ramsey model and generalize it to more complicated scenarios.

### Benchmark model

The Benchmark model is similar to Carlos and Guillermo's [61] benchmark model with small modification.

To make the benchmark model as straight forward as possible while capture the IGT mechanism. I assume that:

1. Economy is static.

2. Only one local government and representative citizen in this economy.
3. Two kinds of goods in the economy which are public good  $G$  and private good  $X$ .
4. Resident spend all their income  $y$ , which is given, on either private goods  $X$  or tax  $\tau$ .
5. The tax is lump-sum tax with no dissertation.
6. Source of government revenue: tax  $\tau$  and transfer  $f$ .
7. Type of transfer: Nonmatching grants, like lump-sum subsidy.

The representative citizen's budget constraint is:

$$y = X + \tau \quad (3.1)$$

The local government's budget constraint is:

$$f + \tau = G \quad (3.2)$$

Combine equation 3.1 and 3.2, I get a budget constraint for the economy:

$$y + f = X + G \quad (3.3)$$

The utility for representative resident comes from the utility of  $X$  and  $G$ . I assume the utility function is the Cobb-Douglas form thus it's a concave utility:

$$U(X, G) = AX^\alpha G^{1-\alpha}, 0 < \alpha < 1 \quad (3.4)$$

For the representative resident, the problem is to choose proper level of  $X$  to maximize the utility in equation 3.4 subject to equation 3.1. The Lagrangian equation can be set up as:

$$L(X) = AX^\alpha G^{1-\alpha} + \lambda_{rc}(y - X - \tau) \quad (3.5)$$

Solving the equation 3.5 will get first order condition(foc):

$$\alpha A \left( \frac{X}{G} \right)^{\alpha-1} = \lambda_{rc} \quad (3.6)$$

$$y = X + \tau \quad (3.7)$$

To solve the Ramsey problem, the Ramsey planner needs to decide the level of  $X, G$  to maximize the utility subject to equation 3.3 and equation 3.2. The Lagrangian can be set as:

$$L(X, G) = AX^\alpha G^{1-\alpha} + \lambda_e(y + f - X - G) + \lambda_{lg}(f + \tau - G) \quad (3.8)$$

Solving the equation 3.8 will generate:

$$\alpha A \left( \frac{X}{G} \right)^{\alpha-1} = \lambda_e + \lambda_{lg} \quad (3.9)$$

$$(1 - \alpha)A \left( \frac{X}{G} \right)^\alpha = \lambda_e + \lambda_{lg} \quad (3.10)$$

$$y + f = X + G \quad (3.11)$$

$$f + \tau = G \quad (3.12)$$

Combining equation 3.9, 3.10, 3.11 will generate:

$$(1 - \alpha)y + (1 - \alpha)f = G \quad (3.13)$$

The flypaper effect definition can be mathematically expressed as  $\frac{dG}{df} - \frac{dG}{dy}$ . Given equation 3.13, the flypaper effect  $fe = 0$ , which means, under this setting, theoretically there should be no flypaper effect.

### 3.1.1.1 Phrase One

Except for the introduction of intergovernmental transfer in 1, One important concern about IGT in economic analysis is the matching mechanism. For matching grants, federal governments will reimburse a specific ratio for each 1 dollar of state and local expenditure. Based on whether federal government set a cap on the matching grants, matching grants can be divided into open-ended matching grants and closed-ended grants.

#### Model with matching grants

I loosen the last assumption in the benchmark model, now the intergovernmental transfer is 100% matching grants which is expressed as  $f_m$ . Suppose the matching ratio is  $m$  and  $0 < m < 1$ . Thus the new budget constraint for local government is:

$$\begin{cases} f_m + \tau = G \\ f_m = mG \end{cases} \quad (3.14)$$

And the budget constraint for the whole economy is:

$$\begin{cases} y + f_m = X + G_M \\ f_m = mG \end{cases} \quad (3.15)$$

Thus the Ramsey problem is to choose proper level of  $X$  and  $G$  to maximize the utility subject to equation 3.15 and equation 3.14. So the new Lagrangian can be listed as:

$$L(X, G) = AX^\alpha G^{1-\alpha} + \lambda_e(y + f_m - X - G) + \lambda_{lg}(f + \tau - G) \quad (3.16)$$

Solving the equation 3.16, I get foc conditions:

$$\begin{cases} \alpha A \frac{X^{\alpha-1}}{G^{\alpha-1}} = \lambda_e + \lambda_{lg} \\ (1-\alpha) \frac{X^\alpha}{G^\alpha} = \lambda_e + \lambda_{lg} \\ y = X + (1-m)G \end{cases} \quad (3.17)$$

By letting focs in equation 3.17 equals to zero, I get following equations:

$$y = \frac{(1-\alpha)(1-m)+1}{1-\alpha} G \quad (3.18)$$

thus the flypaper effect is calculated as  $fe = \frac{dG}{df_m} - \frac{dG}{dy}$  which equals to:

$$\frac{dG}{df_m} - \frac{dG}{dy} = \frac{2m\alpha - 2m - \alpha + 2}{m[(1-\alpha)(1-m)+1]} \quad (3.19)$$

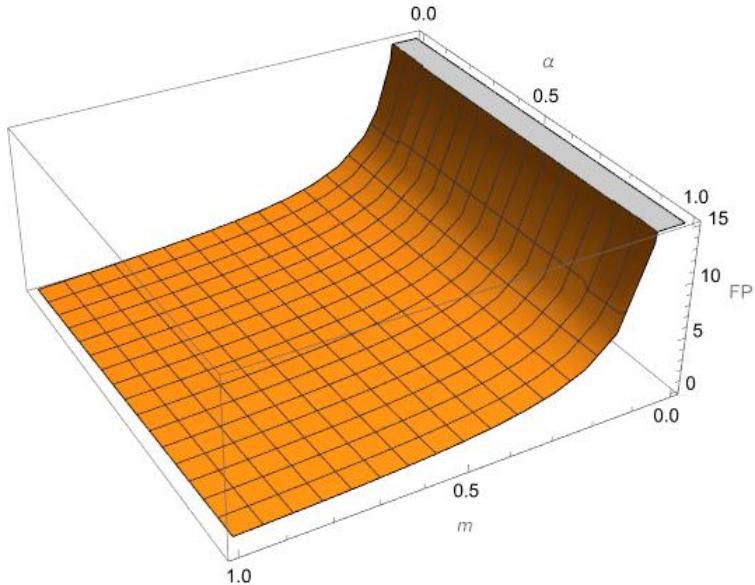


Figure 3.2: Flypaper Effect with Matching Grants

Equation 3.1.1.3 could be proved to be greater than zero, which means for matching grants, the marginal contribution on public spending is higher than the marginal contribution of private income increase.<sup>1</sup>

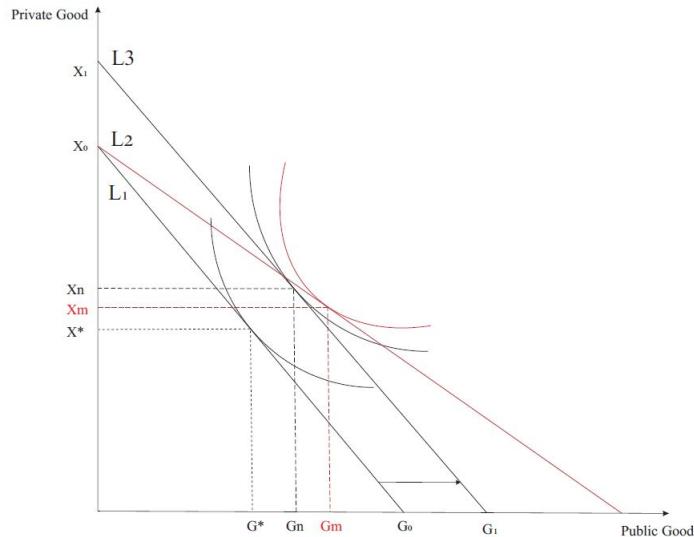


Figure 3.3: Income Effect and Price Effect of Matching and Non-matching Grants

As is shown in figure 3.3, the two parallel lines  $L_1$  and  $L_2$  are budget constraint of the economy before and after the non-matching grants and  $L_3$  is the budget constraint

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<sup>1</sup>The proof process is supplied in Appendix C

with matching grants which is the red line. The difference between  $G_m$  and  $G^*$  is the combination of price effect and income effect of matching grants.

The matching grants model explains why scholars in first stage explain the fly paper effect due to misspecification or omitted variable. Misspecification means researchers may mix up matching grants with lump-sum grants. [62, 63]. Matching grants lower down the marginal price of public services, thus the mix-up will generate price effect and lead to more public goods spending [64]. Some scholars attribute fly paper effects to omitted variables or pre-selection issue. Knight [65] designed a two-level bargaining model to prove that, federal government spread IGT to states and local governments with higher propensity to spend, so the flypaper effect is not a result of IGT. Former observations and investigations has endogenous issue. He also did an empirical test in which he designed an instrument variable to control the endogenous problem. He concludes that once we filter out the pre-selection issue, the flypaper effect is not obvious, at least for the data he collected about interstate highway programs. To summarize, the understanding under this view is that the flypaper effect doesn't actually exist, it's just some kind of misspecification.

### 3.1.1.2 Phrase two

In stage two, scholars start to realize that lump-sum grants also have price effect, which is a huge step. In stage one, scholars recognized the price effect of matching grants, however they don't think that's enough to explain the huge gap in flypaper effect. If non-matching grants also have price effect, then it may be enough to explain. But in this stage, scholars claims that the price effect of non-matching grants exists because of the fiscal illusion. McCulloch [66] argues that taxpayers misperceived the costs of governmental activity, which latterly be summarized as fiscal illusions. The theory of fiscal illusion was first developed by the Italian economist Amilcare Puviani in his 1903 book *Teoria della illusione finanziaria* [67]. Wagner [68] firstly introduced this concept in America and pointed out the effect of fiscal illusion on local governments' spending. Oates and Borge notice the price effect of non-matching grants and try to use fiscal illusion to explain the price effect [69, 70]. The lower-estimated public good price generates a even flatter slope of the budget constraint compared to the  $L3$  in figure 3.3.

Why fiscal illusion exists? Most explanation lies in the institutional setting and administrative transparency. The fiscal federalism setting is too complicated for residents to perceive. For administrative explanation, the administration process is not transparent enough for residents to understand every step. Hence, residents fail to recognize that the

intergovernmental grants are collected from their income as well. Turnbull concludes in his empirical research that imperfect information generates broader fiscal illusion based on the municipal data [71]. Besides, the budget-maximization intention of bureaucratic system are supported by both empirical evidence and theoretical inference [72, 73]. This tendency is referred as "Leviathan government" by some scholars, which means governments seek to maximize their budget rather than maximize residents' utility [74]. Budget-maximizing bureaucrat combined with the lower perceived price of the public goods price leads to a greater expenditure on public goods.

### 3.1.1.3 Phrase Three

In stage three, scholar focus on the effect of the cost of tax collection within the jurisdiction. The cost of tax collection comes from two aspects, one is the distortionary tax. No distortion for recipient tax revenue collection is a strong assumption. In reality, state and local government's tax change lead to an obvious distortion of the residents' behavior. The most apparent case is that residents may want to spend less time on working and more time on leisure once they are not satisfied about the tax and public goods policy, or they just move to another jurisdiction which is also a cost for the tax increase.

Hamilton [54] firstly notices that the distortionary tax within jurisdiction leads to a curved budget constraint, not a straight line.

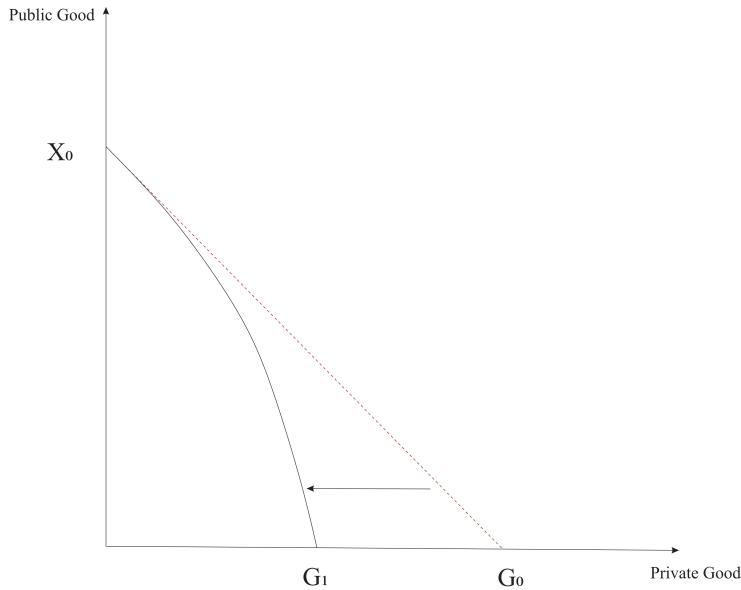


Figure 3.4: Hamilton's Curved Budget Constraint

However, Hamilton's idea was not mainstream at that time. What's more, he identifies

the source of tax collecting cost is deadweight loss, ignores the administrative ability. In fact, the distortion is not the only source of cost. For example, the federal administrative institution is more effective and efficiency in collecting revenue based on the information or ability advantage. Volden [75] designs a game theory model to simulate the interaction of federal government and lower-level governments, he implies that the different cost for federal and state governments to collect revenue partly explains the flypaper effect. Dahlby and Ferede [76] states that the price effect of non-matching grants exists even with no fiscal illusion. Vegh and Vuletin [61] get similar conclusion as well. To summarize, the intuition of these research is straight forward: the collection of tax revenue is too costly for state and local government given the cost may come from both distortion and administrative inefficiency. The state and local government would more like to use “cheaper” resource, which is IGT. Hence, even non-matching grants or lump-sum grants have price effects.

Some horizontal government interaction explains this distortion as well, Brueckner [77] develops a strategic model to analyze the state and local fiscal behavior, he concludes that the lower-level governments are quite sensitive to other competitors. This sensitivity may explain why state and local government don’t want tax increase revenue to cover the public goods. Other horizontal interaction theory such as yardstick competition or tax competition also explains the sensitivity.

I expand the benchmark model by introducing the distortion of tax collection into it.

### **Ramsey Model with Distortionary Tax Collection**

To capture the distortion effect of the tax, I loosen the 3rd and 5th assumption of the benchmark model. I follow the setting by Carlos and Vuletin [61] by adding a taxable private goods  $X_t$  to differentiate with the non-taxable private goods  $X_{nt}$  and capture the distortion effect of proportional tax. In reality,  $X_{nt}$  could express any behavior that representative resident take to avoid the taxation, such as more time on leisure or The assumption on taxation and representative resident’s spending behavior are:

1. Three kinds of goods in the economy which are public good  $G$  and taxable private good  $X_t$  and non-taxable private good  $X_{nt}$ .
2. Resident spend all their income  $y$ , which is given, on either taxable private goods  $X_t$ , non-taxable private goods  $X_{nt}$  or tax.
3. The tax is proportional tax on  $X_t$ , with tax rate  $\theta$ .

So the budget constraint for resident, local government and the whole economy could

be separately list as:

$$y = X_t(1 + \theta) + X_{nt} \quad (3.20)$$

$$f + \theta X_t = G \quad (3.21)$$

$$y + f = x_t + x_{nt} + G \quad (3.22)$$

Different from Carlos' setting who accept a more general setting on residents' and governments' utility, I set Cobb-Douglas form on utility to get a arithmetic solution. Unlike the benchmark model in Carlos' research, in which he set the linear utility, the Cobb-Douglas setting means the imperfect substitute between private and public goods, which is a more reasonable setting. The distribution on  $X_t$ ,  $X_{nt}$  and  $G$  should maximize representative resident's utility and government's utility.

$$\begin{cases} U = AX^\alpha G^{1-\alpha} \\ X = BX_t^\beta X_{nt}^{1-\beta} \end{cases} \quad (3.23)$$

Where  $X$  represent a composite private good. For resident, they need to decide  $X_t$ ,  $X_{nt}$  to maximize  $U$  subject to equation 3.20. For local government, the problem is to decide the distribute of  $X$  and  $G$  to maximize  $U$ , thus the Ramsey problem is to maximize both resident and local governments' utility, which is listed as equation 3.23 subject to equation 3.20 and 3.21. For resident, the first order conditions on  $X_t$ ,  $X_{nt}$ ,  $\lambda_{rc}$  can be listed as:

$$\frac{\partial U}{\partial X} \frac{\partial X}{\partial X_t} = (1 + \theta)\lambda_{rc} \quad (3.24)$$

$$\frac{\partial U}{\partial X} \frac{\partial X}{\partial X_{nt}} = \lambda_{rc} \quad (3.25)$$

$$y = X_t(1 + \theta) + X_{nt} \quad (3.26)$$

Solving equation 3.24, 3.25 will generate the relationship between  $X_t$  and  $X_{nt}$  in equilibrium and the level of  $\theta$ :

$$X_{nt} = \frac{(1 - \beta)(1 + \theta)}{\beta} X_t \quad (3.27)$$

$$\theta = \frac{\beta X_{nt}}{(1 - \beta)X_t} - 1 \quad (3.28)$$

For local government and Ramsey Planner, they need to decide  $G$ ,  $X_t$ ,  $X_{nt}$  subject to

equation 3.21 and 3.22, the FOCs on  $X_t, X_{nt}, G, \lambda_e, \lambda_{lg}$  are:

$$\frac{\partial U}{\partial X} \frac{\partial X}{\partial X_t} = \lambda_e + \lambda_{lg} \quad (3.29)$$

$$\frac{\partial U}{\partial X} \frac{\partial X}{\partial X_{nt}} = \lambda_e + \frac{\beta}{1-\beta} \lambda_{lg} \quad (3.30)$$

$$\frac{\partial U}{\partial G} = \lambda_e + \lambda_{lg} \quad (3.31)$$

$$y + f = x_t + x_{nt} + G \quad (3.32)$$

$$f + \theta X_t = G \quad (3.33)$$

Follow the definition of  $fe$  in equation , the flypaper effect under distortionary taxation can be calculated as:

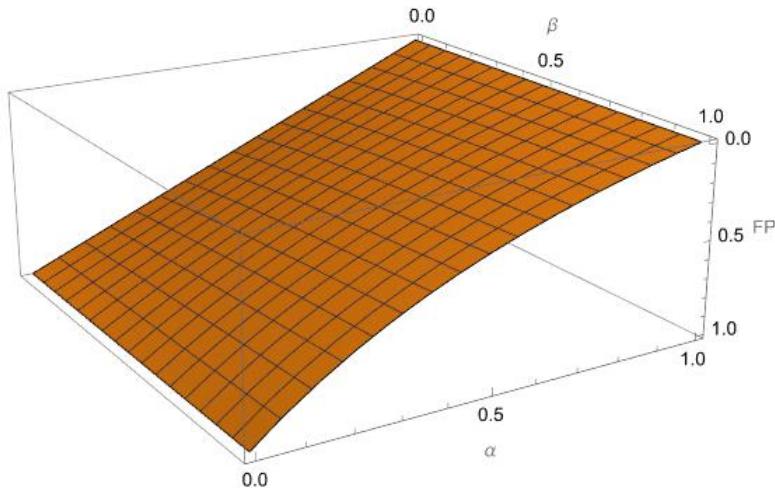


Figure 3.5: Flypaper Effect under Distortionary Taxation

### 3.1.2 Effect of IGT on Local Governments' Spending Segments

Unlike the investigation on overall spending amounts, the understanding of the impact of intergovernmental transfer on micro-segments spending varies. The scholars focus not only on the matching mechanism, but also on restriction of the purpose when analyzing the impact on spending preference. To be more specific, general transfer (such as general revenue sharing in Table 1.1) and transfer with special purpose (such as block grants and project categorical grants Table 1.1) may cause different effect on local governments' spending preference. For one, some empirical evidence still implies the flypaper effect, which means the intergovernmental transfer stimulate local governments' spending in specific area. Feldstein notice the categorical grants in education field from Massachusetts

state government to local governments lead to higher local governments' spending on education [78]. Karnik and Lalvani [79] incorporate the spatial effect into their model when analyzing the data from Maharashtra in India. They found that an increase in intergovernmental grants results in the urban local governments spending more on specific expenditure categories than they would have from an equivalent increase in incomes.

Except for the flypaper effect, another widely discussed phenomenon on categorical governments spending preference is fungibility [56]. The fungibility of intergovernmental transfer means the intergovernmental transfer received by local government would substitute the local government's revenue. Local government may alter the spending structure based on their own preference rather than follow the strings attached on the intergovernmental transfer. One evidence is that subnational governments in Latin America prefer to use the money to cover administrative expense [80]. Once the transfer with specific purpose received by the local governments, the own-generated revenue got crowded out and flow into the preferred area. Another supportive evidence is founded in China. Researchers divides all public spending categories into either productive area, such as the input on infrastructure, or public service area, such as public medicare or education. Empirical evidence implies that local government prefer to crowd out the revenue which should have been invested in public service area and move them to productive spending once they received the intergovernmental transfer even if the transfer is restricted to specific category [81, 82].

One potential issue is that most of the investigation on spending preference focus on the spending sector independently, which is the lower left part of figure 3.1. I think the spending preference could not be investigated in isolation. For example, Thus I incorporate the revenue behavior into the model to evaluate the spending behavior after the introduction of Section 3.2.

Another issue is that most of the investigation mentioned above are empirical evidence without a general framework to explain it theoretically, thus I'll introduce the asymmetric setting into the model to explain the spending preference based on the theoretical setting I generated to explain the flypaper effect.

## 3.2 Effect of IGT on Local Governments' Revenue Collection Behavior

Intuitively, the general transfer should have a substitute effect on local governments' revenue collection effort, which is referred as tax fungibility effect. In some literature, it's called crowding effect on tax effort and it's supported by bunch of scholars [83–85]. Based on this theoretical inference, empirical evidence are founded in both developed and developing countries. Nicholson [86] found the fungibility effect of intergovernmental transfer on tax effort on state level in Germany and America separately. Baretti [87], Aragon and Gayoso [88], Panda [89], Mogues [29] and Bravo [90] found similar evidence in developing countries such as Peru, India, Ghana and Chile. However, the fungibility effect of categorical grants are seldom investigated. To summary, the fungibility of intergovernmental transfer on tax revenue makes governments lower down their effort to collect tax revenue once they got enough funds from transfer payments.

The fungibility effect seems natural when the range of study is constrained in one specific jurisdictions. Once multiple jurisdictions and horizontal competition are introduced into the consideration, one opposite impact also seems to be reasonable. Some theoretical research contend that the local jurisdictions should be motivated to lower the tax burden since they are facing the tax competition. The lower tax burden may attract capital, citizen or enterprise into the area, thus the local governments may actively give up the tax benefits they could have collected. In another word, the tax competition may encourage the local governments to expand the tax base rather than increase the tax effort. The revenue from intergovernmental transfer may neutralize this subjective intention, thus the tax effort would be positively affected. Bucovetsky and Smart [91], Buettner [92] describe this guess in their analysis of fiscal equalization. Liu [93] found some empirical evidence in China. However, compared to the study on fungibility, the investigation on this effect are seldom systematically investigated in theoretical level, limited literature are empirical analysis.

To summarize the literature, there are two potential gaps. Firstly, like the literature on the effect of IGT on local governments' spending preference, the discussion is heavily concentrated on general transfer rather than categorical transfer, thus the effect of categorical transfer on tax revenue collection behavior are barely investigated. Brunt and Khdari [94] did a research about the effect of categorical grants using the data collected in Morocco, unfortunately they do not get a clear conclusion. They ascribe the insignificant result to the political impact thus leave room for local governments to bargain. Secondly,

limited literature focus on the theoretical base of the second effect, which may positively affect the tax effort. Thus I designed a asymmetric setting through a dynamic game with incomplete information to simulate the behavior of central and local governments. And I combine the game theory analysis result with the prototypical benchmark model in section 3.1.1 to connect both spending side (lower left side of Figure 3.1) and revenue side (lower right side of Figure 3.1). This model could be helpful in understanding the central and local governments' behavior on the theoretical level. Finally in Chapter 4, I'll empirically investigate my theoretical inference.

### **3.3 A Dynamic Game with Incomplete Information for Central and Local Governments**

# **Chapter 4 |**

# **Empirical Investigation on Local Governments' Behavior**

**4.1 The Investigation on the tax effort**

**4.2 The investigation on debt and soft budget issue**

# Appendix A | Supportive Data and Figures

## A.1 Data

Table A.1: Data Source and operation for the empirical test in Section 2.3.3

Variables	Source	Time Period
Dependent Variable	lg(igt)	State CAFR
Independent Variables	c p	Ballotpedia
	gdp	FRED
	lgp	
Control Variables	wapw mhi	2000-2019 annually collected Census of bureau
	ur	
	prm	Bureau of transportation statistics

## A.2 Figures

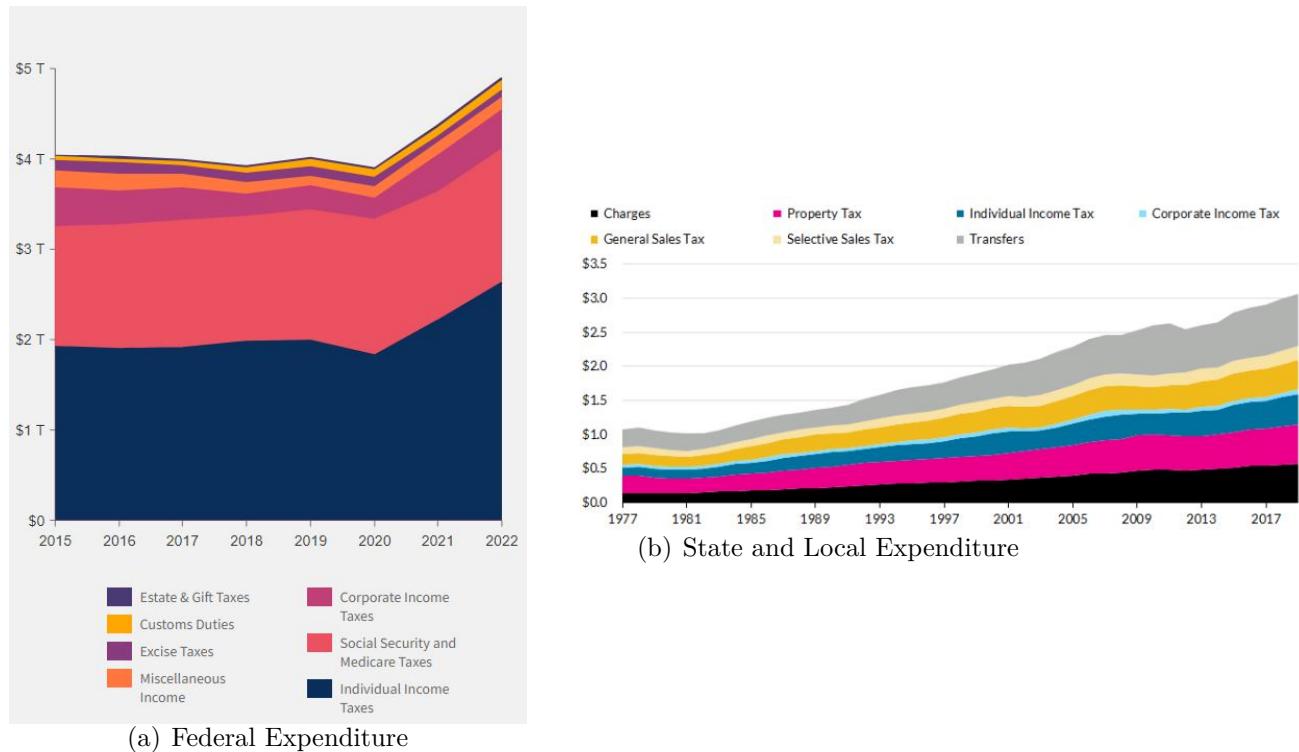


Figure A.1: Fluctuation of Revenue Structure of three level governments. Data Source: US Urban Institute Dataset

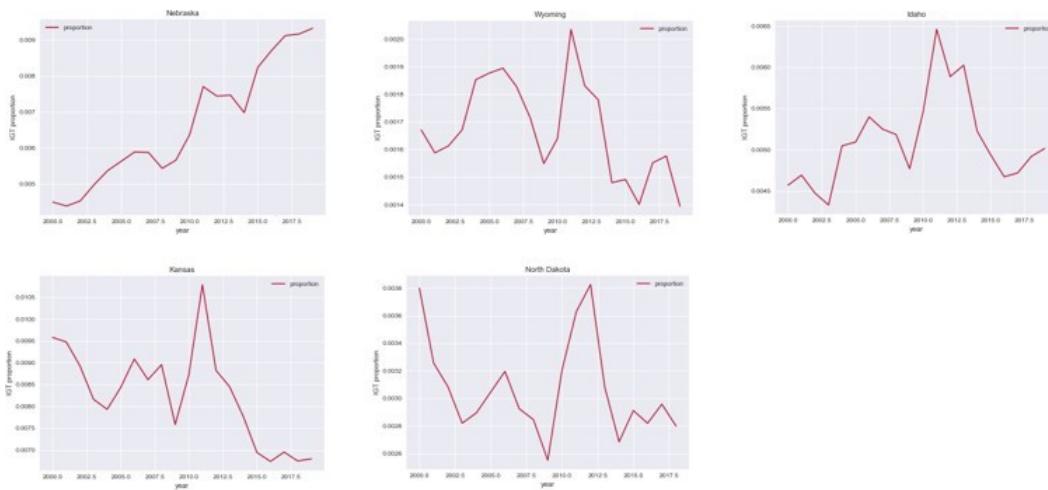


Figure A.2: Time Series Graph of Republican States IGT (2000-2019)

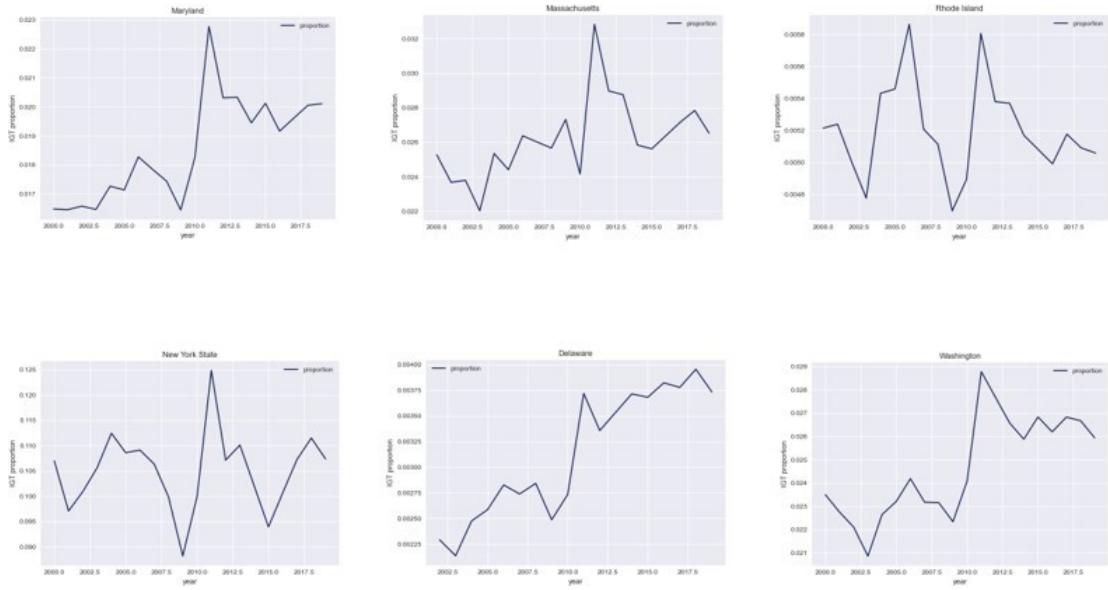


Figure A.3: Time Series Graph of Democratic States IGT (2000-2019)

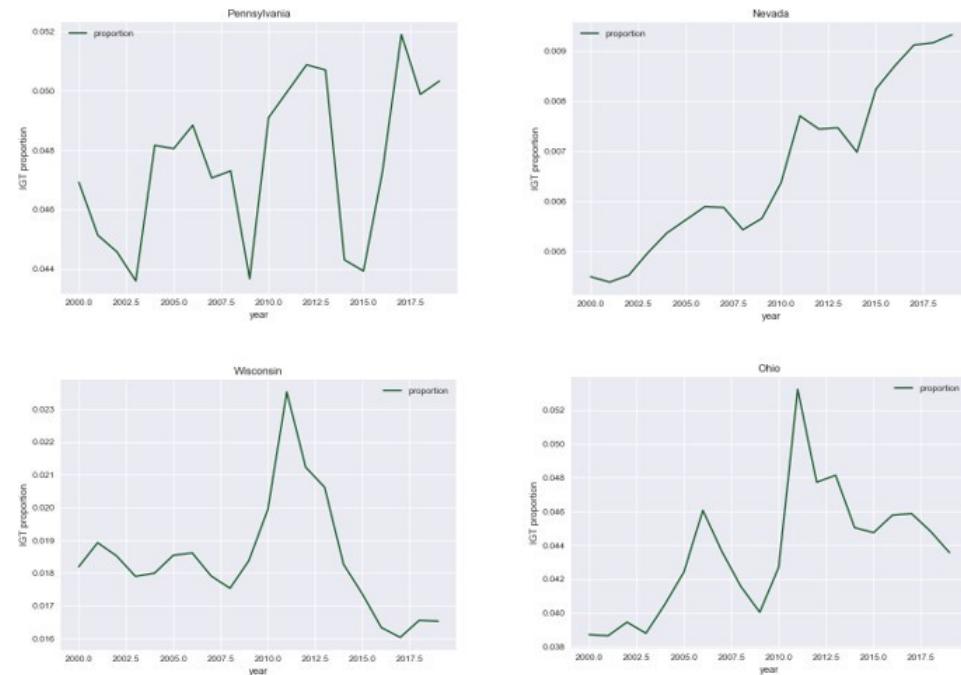


Figure A.4: Time Series Graph of Swing States IGT (2000-2019)

# **Appendix B |**

## **Results**

### **B.1 Introduction**

### **B.2 More Declaration**

# **Appendix C |**

## **Appendix for the proof**

### **C.1 Introduction**

### **C.2 More Declaration**

# **Appendix D |**

# **Title of the Fourth Appendix**

**D.1 Introduction**

**D.2 More Declaration**

# **Appendix E|**

# **Title of the Fifth Appendix**

## **E.1 Introduction**

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**Vita**  
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The details of my childhood are inconsequential.