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Three Essays on Fiscal Federalism and the Role of Intergovernmental Tranfers

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THREE ESSAYS ON FISCAL FEDERLISM AND THE ROLE OF INTERGOVERNMENTAL TRANSFERS

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Business and Economics
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By

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ABSTRACT OF DISSERTATION

THREE ESSAYS ON FISCAL FEDERLISM AND THE ROLE OF INTERGOVERNMENTAL TRANSFERS

This dissertation is composed of three essays, each examining a unique question relating to the role of intergovernmental transfers in fiscal federalism.

Using a panel of the 48 contiguous U.S. states along with recent advances in nonstationary panel and spatial econometric methods this dissertation offers a number of important insights into the workings of intergovernmental transfers and therefore a clearer understanding of the interactions among the different layers of government.

The third chapter examines the relationship between intergovernmental revenues from the federal government and intergovernmental expenditures to local governments. As observed by Wildasin (2010), there remains remarkable stability in the ratio of state-to-local transfers to federal-to-state transfers despite the disparate programs being financed by each. Therefore, the purpose of this essay is to examine the extent to which states serve as a conduit for funds from the federal government to local governments. In particular, the research question asks to what degree do federal transfers stimulate transfers to local governments.

The fourth chapter explores the direction of causality between tax revenues and expenditures in answering the four hypotheses set forth in the literature: tax-spend, spend-tax, fiscal synchronization, and institutional separation. Furthermore, along with exploring the role served by intergovernmental transfers within the revenue-expenditure nexus, this essay also examines differences relating to the revenue-expenditure nexus between states with relatively higher debt levels and states with low debt levels, in order to better understand the fiscal causal links favorable for debt accumulation.

The purpose of the fifth chapter is to ascertain the effect interstate fiscal interactions on the stimulative effect of grants on state level expenditures. The vast literature on fiscal competition suggests that states do not make decisions in isolation, therefore, spatial

econometrics are used to capture spillovers and mimicking behavior across states. Following Boarnet and Glazer (2002), the effect of informational externalities arising from grants awarded to neighboring states are examined as well as the effect of spending spillovers from neighboring states. The results show that the flypaper anomaly (i.e. the stimulative effect of grants greater than a pure income effect) can be explained by interstate fiscal interactions.

KEY WORDS: intergovernmental transfers; flypaper effect; fiscal federalism; dynamic panel estimation.

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1 Introduction

1.1 Overview

The growth in government spending in the U.S. has been substantial over the past several decades, particularly at the state level. For instance, state spending has increased from fifteen percent of total government spending in 1960 to twenty-four percent in 2008. The composition of spending has also changed dramatically within this time frame. For example, the federal government has shifted away from defense spending and toward spending on social insurance programs. Along with these changes spending responsibilities have devolved down to subnational governments and the use of intergovernmental transfers have increased. Federal transfers were fifteen percent of total state revenues in 1951 and twenty-six percent in 2008. This large increase in federal transfers as a funding source for states warrants an investigation as to the influence of these transfers on other fiscal variables, namely expenditures and revenues. The increased use of transfers have the potential to elicit perverse behavior among grant recipients through the shifting of spending and own revenues over programs and over time. For instance, federal grants in the US are used to a large extent to internalize spillovers; however, the "cognitive distance" between the central government and its residents pose questions as to what extent the federal government possesses knowledge of the optimal level of local public goods and therefore can effectively provide the correct level of grants necessary to internalize interstate spillovers. Recently, however, the federal government has moved away from matching grants and toward block grant programs such as in the case of welfare, affording states more autonomy in creating more state-specific welfare programs. Moreover, the special role served by transfers in linking all three layers of government together offers many interesting questions as to the interactions of each layer of government. For example, federal grants also have the potential of introducing additional externalities (see Chapter 4 for more details on this idea), which further complicate state fiscal policy. Therefore, given the state's unique position as an intermediary between the federal and local governments, understanding how policy makers at this level spend grants is of special interest throughout this dissertation.

The main focus of this dissertation is understanding how states allocate federal transfers. My findings shed light on the use of transfers, which, in turn, should assist in the development of more efficient transfer policies and provide an understanding of how citizen preferences are being represented by government. Furthermore, through the use of recent developments in nonstationary panel and spatial econometric techniques, this dissertation offers a better understanding of the dynamic and spatial relationships among fiscal variables across states. A number of these fiscal interactions take place over time, while displaying an appreciable amount of adjustment following fiscal shocks. By focusing solely on snap shops of these relationships, as is common with past studies, overlook the informative adjustment process unfolding over time as fiscal variables return to equilibrium.

1.2 Theory of State and Federal Government Interaction

1.2.1 Fiscal Federalism

Fiscal federalism, according to Wildasin (2008), is concerned with the division of policy and responsibility among different levels of government as well as the interactions among the layers of government. Earlier works in this area focus on the allocative benefits of decentralization. For instance, Hayek (1945) discussed advantages of decentralized decision making as the best way to utilize what is essentially localized knowledge. Similarly, local governments are in the best position to utilize this knowledge as they are "closer to the people." In accordance with Oates' Decentralization Theorem lower-level governments are in a better position to provide the level of public services that match the local benefits and costs that vary across locations with different demographic composition, income and technologies. Moreover, local governments may also be more informed and responsive to local demands (Wildasin, 2008). An added benefit of decentralization is that of revealed preference by mobile households. Tiebout (1956) argued that efficient provision of public goods can be generated through the sorting of households among heterogeneous localities in which their decision where to reside reveals their preference for local public services.

Later works involved addressing the tax/expenditure assignment problem. In reference to Musgrave's (1959) three branches of government activity the general consensus, according to (see Oates, 1972), is that the highest level of government should be responsible for the stabilization function (i.e. macro and monetary policies) and higher levels of government should be responsible for the distribution of income. Alternatively, lower-level governments should be responsible for the allocative function in which they provide public services and correct market failures. Of course, grants are an important instrument in fiscal federalism that can be used by higher level governments to serve a number of purposes. The literature, according to Oates (1999), outlines three such roles served by grants in fiscal federalism: (1) internalizing spillover benefits to other jurisdictions; (2) fiscal equalization across jurisdictions; and (3) improved overall tax system. Federal-to-state grants in the U.S. have been less focused on equalization and instead distributed for specific programs, but state-to-local grants do possess equalization features such as with school districts (Oates, 1999). One disadvantage of fiscal decentralization is the possibility of inter-jurisdictional spillovers leading to inefficient levels of public goods. For instance, Case (1993) discusses possible externalities arising from spending on highways, education and welfare. Within a federation, however, higher-level governments can use intergovernmental grants to correct these externalities and achieve an efficient level of public goods (Breton, 1965). Also, according to Buettner (2006), these intergovernmental transfers can be used as instruments to elicit certain behavior among recipient governments. For example, consistent with the stabilization function, higher-level governments can also use intergovernmental grants to induce spending by lower level governments with the intentions of increasing aggregate demand in times of recession (Hines, 2010).

Given the global trend of decentralization through the use of intergovernmental

transfers, instead of tax devolution, the literature has recently stressed the importance of using own revenues sources to finance expenditures. Recently, the literature, particularly, Weingast (1995) and McKinnon (1997), has articulated the dangers inherent in fiscal federalism when decentralized governments rely too heavily on grants from upper-level governments. Moreover, Rodden *et al.* (2003) declares that intergovernmental grants tend to distort rather than illuminate the link between taxes and benefits increasing the likelihood of fiscal illusion. Further, he argues that local governments have incentives to exaggerate costs and information to reign in more transfers from higher-level governments. The perverse incentives and problems of soft budget constraints has encouraged discussions on how to remedy these issues by relying on more "market-based" approaches like private credit markets.[1]

Aside from the many advantages associated with decentralization including increased accountability, decentralization also creates spillovers and competition among jurisdictions that potentially offset the efficiency gains from decentralization. Alternatively, Brennan & Buchanan (1980) argue that instead of being benevolent planners, governments are budget maximizers trying to extract as much tax revenues as possible. If this view is correct then fiscal competition among governments would be efficiency enhancing by constraining the Leviathan. Also, the nature of decentralization matters. For instance, Rodden *et al.* (2003) tax and expenditure devolution is necessary to constrain Leviathan by encouraging tax competition among jurisdictions and thus tightening up the link between taxes and benefits.

1.2.2 The Flypaper Effect

To understand the uses of intergovernmental transfers the median voter model is typically used to empirically model the demand for local public goods, where the government is assumed to maximize the representative citizen's utility subject to a budget constraint consisting of grant income and community income. The first order conditions therefore delineates the representative demand for public goods and describes the marginal propensity to spend grant income and community income. Bradford & Oates (1971) provide the theoretical framework for understanding the response of subnational governments to increases in intergovernmental aid. They show that the effect of matching grants on subnational government spending can be decomposed into an income effect and a reinforcing substitution effect, and will therefore have a larger effect on spending than an increase in lump-sum grants which result in a pure income effect. Furthermore, Bradford & Oates (1971) show that intergovernmental aid distributed at a fixed rate to individuals in the community will have the same effect on disposable income and public goods as intergovernmental aid distributed directly to the citizens. Moreover, if lump-sum grants to a collectivity are allocated based on individuals' tax share, the effect of an increase in lump-sum grants and a comparable increase in income should have an equivalent effect on government spending.

[1]For more discussion on market-preserving fiscal federalism see Weingast (1995) and McKinnon (1997).

However, much of the empirical evidence contradicts the theoretical predictions of Bradford & Oates (1971) (see, e.g., Gramlich, 1977; Inman, 1979; Fisher, 1982; Hines & Thaler, 1995). Instead, the empirical estimates consistently find that the stimulative effect of federal transfers is much greater than that of community income. After Gramlich presented his findings that grants-in-aid stimulate local government expenditures more than an equivalent increase in income, Arthur Okun coined this the "Flypaper effect," since money tends to "stick" where it hits, or in other words, money to the public sector stays in the public sector and money in the private sector stays in the private sector. The empirical literature to date has found that the marginal propensity to spend $1 of private income is in the range of $0.05-$0.10, whereas the marginal propensity to spend $1 of grant income is between $0.30 and $1.00 (Inman, 2008).

More recently, asymmetric responses to federal transfers have been examined (see, e.g., Shaw, 2005; Heyndels, 2001). For instance, Gramlich (1987) found that for local government spending in the US, when unconditional grants decreased, fiscal replacement with own-source revenues was less than 100%. Looking at local governments in Pennsylvania, Stine (1994) finds evidence that grant cuts lead to a decrease in own-source revenues and Deller & Maher (2006) finds evidence of fiscal replacement of unconditional grants in county governments of Wisconsin. Furthermore, a working paper by Tuttle (2004) finds asymmetric responses to grants-in-aid of state and local governments, finding evidence of a flypaper effect only when grants-in-aid are rising.

As discussed by Bradford & Oates (1971), the strength of the flypaper effect relates to the degree of grants fungibility. The program being stimulated by federal grant funds is also distorted by grant fungibility. For instance, if transfers are completely fungible it is not clear that transfers are ameliorating problems associated with interstate spillovers as intended. Moreover, displacement of fiscal resources brought about by federal grants has important implications pertaining to grant effectiveness. Using pooled cross-country time-series data (see, e.g., Feyzioglu *et al.*, 1998) and country-specific time series data (see, e.g., Pack & Pack, 1990, 1993) many studies have investigated the degree of fungibility with respect to grants and the relationship with government expenditures and find a significant amount of fungibility with respect to grants.

There has been a number of possible explanations (both empirically and theoretically) for the existence of a flypaper effect. Inman (2008) notes several explanations common in the literature. The first is that researchers tend to confuse matching grants as lump-sum grants. However, the flypaper effect still remains even after correcting this misclassification (Wyckoff, 1991). Omitted variables are another explanation for finding a flypaper effect. Variables that are determinants of government spending and correlated with income or aid can bias the estimates of income and grants. Though, Inman (2008) assures that the omitted variable bias alone is not sufficient to explain the flypaper effect. A third explanation is that citizens perhaps do not understand the complexity of grants. For instance, Oates (1979) maintains that the flypaper effect is valid and can be explained by citizens misinterpreting lump-sum grants as matching grants as what he calls a fiscal illusion. Fiscal illusion is when citizens view exogenous grants as lowering the marginal price of the public good as well as

increasing community resources. By interpreting lump-sum grants as having a substitution effect can then translate to a flypaper effect (Tresch, 2002). Fisher (1982) disagrees with the idea of fiscal illusion and instead suggests that voters are savvy enough to understand that grants increase community income and that grants come from taxes collected from higher levels of government. Consequently, the net increase in resources would be the difference between tax payments to the government and the increase in grants. Therefore, a general equilibrium approach is more appropriate to that of partial equilibrium.

Alternatively, politics could explain the flypaper effect. As discussed by Inman (2008), the flypaper effect is a consequence of the inability for voters to write complete contracts with their elected officials. Bae & Feiock (2004) present findings consistent with political institutions explaining the flypaper effect within a median voter model. Brooks & Phillips (2010) also provide an institutional explanation for the flypaper effect, but instead they find that governments use grant income to supplement total expenditures and therefore are not likely to return augmented revenue from grants to citizens in the form of tax cuts. Furthermore, Tovmo & Falch (2002) conclude that a unified political environment reduces the flypaper effect. Finally, Aragon (2008) provides a theoretical model explaining the existence of the flypaper effect to be a by-product of costly tax collections. In sum, the flypaper effect remains a robust empirical finding throughout the literature.

1.3 Chapter Summaries

This dissertation offers a number of contributions to the public finance literature, particularly in understanding the states' use of federal transfers. This section highlights the contribution and results from each chapter.

1.3.1 Chapter 3: Exploring the Dynamics of Intergovernmental Linkages: Is the State a Conduit for Funds?

The third chapter examines the extent to which states funnel federal transfers down to local governments. As observed by Wildasin (2010), there exhibits a close stable relationship between federal-to-state transfers and state-to-local transfers that persists over multiple decades. For example, since 1992 the ratio of state-to-local transfers to federal-to-state transfers has never dipped below eighty percent. These observations bring forth questions concerning the states role as a "conduit" for funds from the federal to local governments. The results indicate that in the short run states use transfers to fund their own-expenditures, but the long run is consistent with the idea that states are serving as a conduit for funds, since federal transfers are, to a large degree, being funneled down to local governments. For instance, about \$0.09 of every federal transfer dollar is spent on aid to local governments in the short run, whereas in the long run about \$0.60 of every federal transfer dollar is used to fund intergovernmental expenditures to local governments. This result shows that although the flypaper effect exists in both the short and long run, the use of grant funds is very different. In accordance with the demands from the median voter state governments

appear to funnel federal transfers to local government in the long run. This result is consistent with idea that governments closer to the people are in a better position to be controlled and held accountable by the citizens. Furthermore, in line with Oates' Decentralization theorem, local governments are better able to match the costs with the benefits of providing local public goods. Disaggregated transfers unveil evidence of resource diversion in which federal transfers allocated to specific programs are funneled to local governments in the form of transfer expenditures allocated to programs far removed from which they were originally intended. The most striking result is the use of federal public welfare and health and hospital transfers used to fund education transfers to local governments. To this effect, the intermediary role that states serve between federal and local governments offers an avenue for resource diversion, which could potentially exacerbate, rather than alleviate, inter-state spillovers, especially in the presence of fiscal competition. However, this could be efficiency enhancing if state governments possess more knowledge of the efficient level of public services and is therefore given the autonomy to internalize these spillovers through block grants from the federal government.

1.3.2 Chapter 4: The Dynamics of the Revenue-Expenditure Nexus in State Government Finances

The fourth chapter examines the Granger causality between taxes and expenditures in answering the four hypotheses set forth in the literature: tax-spend; spend-tax; synchronization; institutional separation. Aside from being the most recent look at the revenue-expenditure nexus, this essay contributes to the literature by providing a more comprehensive look at the effect of federal transfers within the tax-spend nexus, as opposed to previous studies which assume a more passive role for transfers. Furthermore, this essay contributes to the literature by providing a deeper understanding of the revenue-expenditure dynamics that are conducive to debt accumulation. The large increases in federal-to-state transfers and the problems of debt plaguing most U.S. states makes this is a very timely topic. Overall, the results display evidence in favor of the tax-spend hypothesis (i.e. unidirectional causality from taxes to expenditures) which is consistent with Friedman (1978) hypothesis that governments exploit tax increases by increasing spending. In contrast, the short run exhibits institutional separation (i.e. the absence of a causal relationship between taxes and expenditures). Transfers also play a key role in returning state budgets back to equilibrium. Moreover, the results reveal that high debt states exhibit more precarious budget setting dynamics compared to low debt states. Specifically, not only is there evidence of institutional separation in the short run, but taxes and expenditures are diverging. Also, tax revenues are used to retire debt obligations in low debt states, whereas high debt states use federal transfers to retire debt obligations revealing potential moral hazard problems. These results suggest to policy makers that the proper response to budget deficits include adjusting taxes in the long run in order to bring the budget back to equilibrium. Alternatively, in the short-run some combination of tax and expenditure adjustment might be necessary with specific focus on reestablishing the short-run link between taxes and expenditures. With respect to the high debt states,

the primary focus should be in reversing the divergent time paths between taxes and expenditures in order to return these states back on a sustainable path in the short run. However, a long run approach should include some form tax cuts and loosening the link between transfers and the revenue-expenditure nexus.

1.3.3 Chapter 5: An Empirical Investigation of Fiscal Interactions and the Flypaper Effect

The fifth chapter explores the influence of fiscal competition on the stimulative effect of federal transfers on state expenditures. Traditional estimates of the flypaper effect assume governments make decisions in isolation. Following Boarnet & Glazer (2002), this is relaxed by considering spatial interactions over expenditures and by considering the informational externalities provided by federal transfers awarded to neighboring states. This essay expands on the work done by Boarnet & Glazer (2002) in a number of ways. First, given that expenditures don't instantaneously adjust to grant stimulus, and instead, exhibit signs of significant adjustment over time, the assumption of instantaneous adjustment is relaxed and instead partial adjustment is assumed. Second, the indirect effect of spending spillovers on federal grant stimulus is estimated. Last, the robust econometric technique used offers a number of benefits such as circumventing problems associated with measurement error and weak instruments, correcting for endogeneity of the explanatory variables, and allowing for dynamic relationships. The results suggest that federal transfers to recipient governments serve as an important informational externality that voters use to evaluate policies of elected officials. Consequently, transfers to recipient governments mitigate federal transfer stimulus on own-expenditures. Furthermore, neighboring state expenditures produce significant spillovers that also dilute the stimulative effect of grants. The omitted variable bias, from neglecting neighboring state policies offer a complete explanation for the flypaper phenomenon.

1.3.4 Contributions and Policy Relevance

The results of this dissertation motivate further research on the dynamic interrelationships among important fiscal variables including intergovernmental grants with each chapter addressing a unique question pertaining to the effect of federal grants on state level fiscal policy. Particularly, one of the issues plaguing the majority of studies in fiscal federalism is the lack of dynamics in the analysis. The effect of grants on fiscal variables is a process that unfolds over time and therefore any study using cross-sectional averages or single year snap shots are only capable of offering a very limited understanding of fiscal federalism, which is itself a very dynamic process. To help fill this void, each chapter in this dissertation views this as a dynamic process with an appreciable amount of adjustment unfolding over time. The results, therefore, inform policy makers with the underlying adjustment process of many important fiscal variables.

For instance, the third chapter examines the possibility that states funnel federal grants down to local governments; the fourth chapter looks at the state's use of

transfers within an intertemporal budget constraint in order to understand how grants influence such fiscal variables as own-revenues, expenditures and debt; and the fifth chapter tests whether grants to recipient governments give off informational externalities and to what extent spending spillovers from neighboring states inhibit grant stimulus. In regard to the debate about decentralization, Chapter 3 looks at what fraction of federal aid the median voter demands to be allocated to local governments. This chapter also looks at disaggregated transfer categories to understand the interrelationships among the various programs funded by transfers at the different levels of government. The considerable degree of autonomy possessed by state and local governments serve as an impetus to divert resources away from where higher level of governments originally intended. This of course could mean that inter-jurisdictional spillovers are not corrected and therefore matching grants,as opposed to block grants, should be used, or that lower-level governments possess more knowledge of the local situation and thus block grants would be efficiency enhancing. Furthermore, the overall destination of grant funds varies over time since federal grants immediately stimulate direct expenditures, but over time flow to local governments for various programs that are, at times, far removed from their original intended allocated by higher level governments. From the perspective of the federal government grants should be restructured to include, not only a matching component, but also a time component. The matching and time component could be interdependent so that the longer the expenditures on a certain project are maintained the larger is that matching rate. However, the state governments offer a level "closer to the citizens" in which they can better provide an efficient level of public goods and therefore block grants would be more appropriate.

The fourth Chapter examines the role of federal grants in the state government's intertemporal budget constraint. Specifically, this chapter addresses the direction of causality among the various fiscal variables. The results inform on issues such "soft" budget constraints and perverse incentives that are at times and outcome of intergovernmental grants. For example, states that possess relatively more debt appear to rely more heavily on federal grants to finance outstanding debt. Moreover, the causal direction between taxes and expenditures favors Friedman's (1978) hypothesis in which state governments use tax revenues to increase the size of government, therefore tax cuts are necessary to reign in spending and control budget deficits. This chapter provides some evidence in favor decentralization through tax devolution instead of using federal grants consistent with that found by Rodden *et al.* (2003). The two advantages of tax devolution, according to this analysis, would be a tighter match between taxes and benefits and, the increase in tax competition that would limit the resources state governments can use to encourage overspending. This would mitigate the need for bailouts by higher-level governments and force state governments to instead rely on the discipline given off by private credit markets.

Chapter 5 examines the effect of fiscal interactions on the flypaper phenomenon. Specifically, this chapter looks at externalities generated by the federal government through distributions of federal grants as well as spending spillovers from neighboring states. The results in this chapter find that grants give off extensive informational externalities that, although increase own-state spending, limit neighboring state spend-

ing. Consequently, grants used for the purposes of increasing aggregate demand would have limited effects on total state spending during times of recession. Moreover, as the federal government internalizes interstate externalities through the use of grants in one state, they subsequently, generate additional externalities as neighboring states respond to these grants by lowering their expenditures. These results suggest possible efficiency gains from a further devolution of taxing authority and less reliance on grants. Since grants themselves generate externalities then it would appear to be more efficient to allow states to determine the level of taxes that match spending and forces states to be more diligent in matching taxes with spending, especially during times of recession. Furthermore, the externalities associated with grants as well as spending spillovers are able to explain, almost completely, the flypaper phenomenon commonly found in the empirical literature. Therefore, it is important to consider neighboring state policies when examining the flypaper effect as well as in designing and distributing grants.

2 An Overview of State-level Spending and Revenue Trends

2.1 Introduction

The data used throughout this dissertation are based at the state level. State level observations are an interesting case within a federation as states are an intermediary between the federal and local governments. This intermediary position between the federal and local governments allows one to better understand the linkages among these governments. For instance, the state can be seen as a means for aligning the incentives of the central government and local governments or as a mechanism through which citizen preferences are relayed from local governments to the central government. Moreover, while examining the dynamics and spatial relationships across fiscal variables it is important to separate out local governments as they have a significant amount of tax and spend autonomy and deserve to be studied separately. States in the US offer a very rich data set both across time and cross-sections allowing researchers to exploit the variation across both dimensions. Moreover, being in a federation, states are largely homogeneous which help mitigate problems of estimator identification.

2.2 Description of the Data

The data consist of annual observations of the forty-eight contiguous U.S. states over the period 1951 to 2008. Hawaii and Alaska were omitted due to their lack of sufficient data and lack of spatial neighbors. State level variables are collected from the Annual Survey of State Government Finance and Census of Governments from the US Census Bureau. These include, total expenditures, direct expenditures (i.e. intergovernmental expenditures to local governments subtracted from total expenditures), intergovernmental expenditures to local governments (local government aid), intergovernmental revenue from the federal government (federal aid), own revenues (i.e. transfer revenues subtracted from total revenues), tax revenues, total personal income and total debt outstanding. Control variables collected from the the UK poverty Center (http://www.ukcpr.org/) include the poverty rate and a dummy variable for the governor being a member of the democratic party. Population and land area by state (used to construct population density) along with the GDP deflator were collected from the Bureau of Economic Analysis. Population demographics used to calculate the dependency ratio (population aged 0-19 and 65+ divided by the population aged 20-64) were collected from the Census Bureau. Finally, the unemployment rate is collected from the Bureau of Labor Statistics.

2.3 Summary Statistics

This section provides a number of summary statistics. Table 1 breaks down the summary statistics, per capita and as a percent of income, by decade from 1960 to 2008. The first thing to note is the extraordinary increase in the size of state level governments in terms of expenditures and own revenues on a per capita basis. Moreover, debt and federal transfers have increased tremendously from a per capita

mean of $27 and $13, respectively, in the decade 1960-1969 to $2721 and $1290 in the decade 2000-2008. The largest increase in expenditures and transfers was from the 1960's to the 1970's. Perhaps not surprisingly, this is the decade President Johnson signed the Equal Opportunity Act of 1964 into law as a means of attacking American poverty and then shortly after Medicare and Medicaid were signed into law. Debt, on the other hand, had the largest increase in the decades following the 1970's. The last two columns show the mean and standard deviation for each fiscal variable as a percent of personal income. One thing to note is the increase in the size of state governments over time. Expenditures went from ten percent of income in the 1960's to fifteen percent of income in the 21st century. Similarly, debt has also increased as a fraction of income, going from five percent in the 1960's to eight percent in the 2000's. In contrast, own revenues increased from eight percent to only twelve percent and tax revenues remained remarkably constant at approximately six percent over the time period. This suggest that states are relying more heavily on other revenue sources other than tax revenues to finance expenditures and debt.

Table 2 provide the mean and standard deviation of three major revenue sources as a percent of total revenue before 1980 and after 1980. It is interesting to note that where federal transfers increased slightly, the mean of tax revenues decreased by eight percentage points and other revenues increased by eight percentage points, again, suggestive of the increase reliance on other revenues as opposed to tax revenues to finance expenditures and debt.

2.4 Spending and Revenue Trends

This section documents trends over time using cross-sectional averages. Figure 1 shows per capita trends in tax revenues, other revenues and transfer revenues. Notice, that tax revenues and federal transfers follow a smooth increasing trend, whereas other revenues are more erratic and tend to follow business cycle fluctuations. For example, other revenues dropped off significantly in recessionary periods in the early and the latter part of the 2000's. Tax revenues also dropped off slightly coinciding with the recession in the early 2000's.

Figure 2 shows the time-series relationship between expenditures and revenues. Notice not only the increase in expenditures and revenues over time, but also the close relationship between transfer revenues and transfer expenditures and between own expenditures and own revenues. These observations hint at the idea that states use own revenues to finance own expenditures and transfer revenues to finance transfer expenditures.

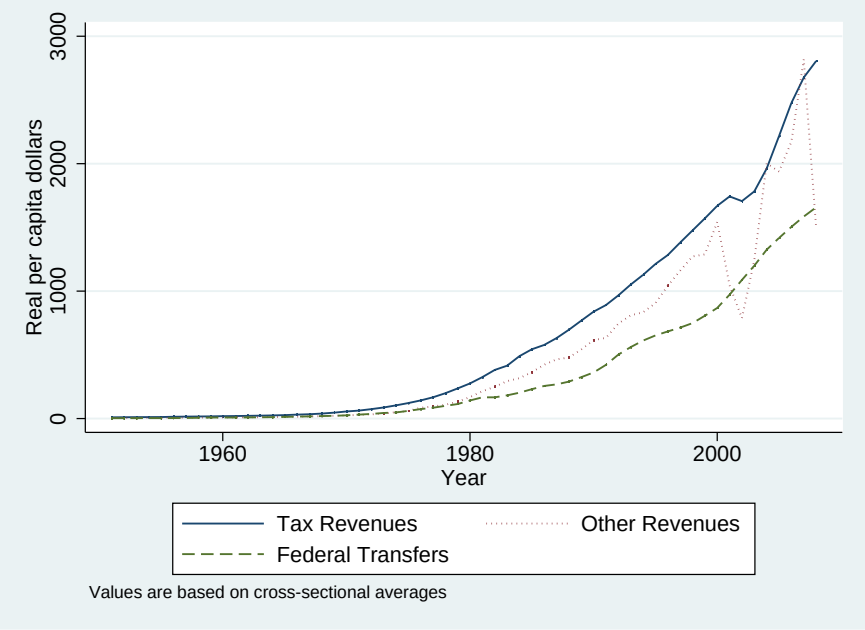


Figure 1: Trends in Revenue Sources

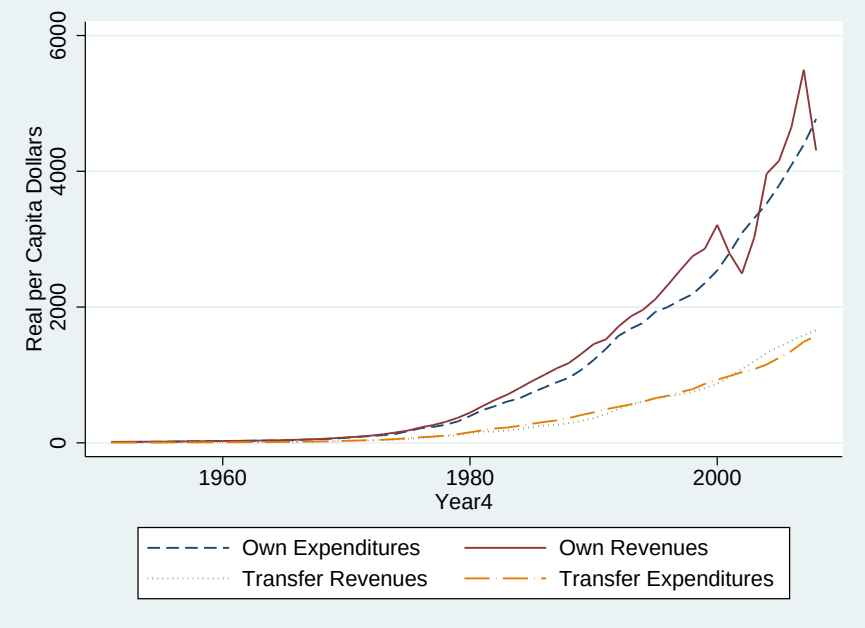


Figure 2: Trends in Expenditures and Revenues

Table 1: Summary Statistics by Decade

	Mean	Standard Deviation	Mean	Standard Deviation
	Per Capita		% Income	
Period 1960-1969				
Expenditures	53.86	21.36	9.94	2.65
Federal Transfers	13.25	7.42	2.48	1.20
Own Revenues	41.93	16.02	7.70	1.73
Other Revenues	13.50	6.83	2.45	0.95
Tax Revenues	28.43	10.67	5.25	1.20
Debt	27.04	24.00	4.81	3.42
Period 1970-1979				
Expenditures	239.50	119.59	11.96	2.38
Federal Transfers	61.67	33.49	3.11	1.00
Own Revenues	190.18	102.13	9.34	1.73
Other Revenues	65.50	42.75	3.13	1.03
Tax Revenues	124.68	63.69	6.21	1.14
Debt	108.79	110.46	5.29	4.08
Period 1980-1989				
Expenditures	987.48	357.65	12.24	2.67
Federal Transfers	222.98	84.72	2.83	0.90
Own Revenues	861.71	344.55	10.55	2.51
Other Revenues	351.35	173.10	4.29	1.59
Tax Revenues	510.36	194.68	6.26	1.26
Debt	601.13	483.05	7.12	4.69
Period 1990-1999				
Expenditures	2460.80	649.66	13.70	2.64
Federal Transfers	606.18	212.39	3.40	1.11
Own Revenues	2110.29	638.50	11.64	2.26
Other Revenues	930.51	367.23	5.12	1.56
Tax Revenues	1179.78	339.53	6.53	1.14
Debt	1426.36	1028.81	7.72	4.73
Period 2000-2008				
Expenditures	4797.06	1309.24	14.74	2.98
Federal Transfers	1290.78	494.69	4.02	1.42
Own Revenues	3787.79	1290.89	11.54	2.98
Other Revenues	1672.40	860.57	5.09	2.43
Tax Revenues	2115.38	638.76	6.44	1.20
Debt	2721.03	1746.54	8.02	3.93

Notes: Values in columns 1 and 2 are per capita 2005 dollars and values as a percent of income are in columns 3 and 4.

Figure 3 normalizes each fiscal variables by total personal income. All three variables display an increasing trend over time suggesting that state governments are spending a larger share of the state's income. For instance, expenditures as a percentage of income ranged from a low of 7.5% to a high of 16%; own-revenues as a

Table 2: Summary Statistics by Sample Split

	Mean	Standard Deviation
Period 1951-1980		
Federal Transfers	21.94	6.32
Tax Revenues	52.51	8.02
Other Revenues	24.45	7.24
Period 1981-2008		
Federal Transfers	22.74	5.19
Tax Revenues	44.24	6.93
Other Revenues	32.14	7.12

Notes:Values are a percent of total revenues.

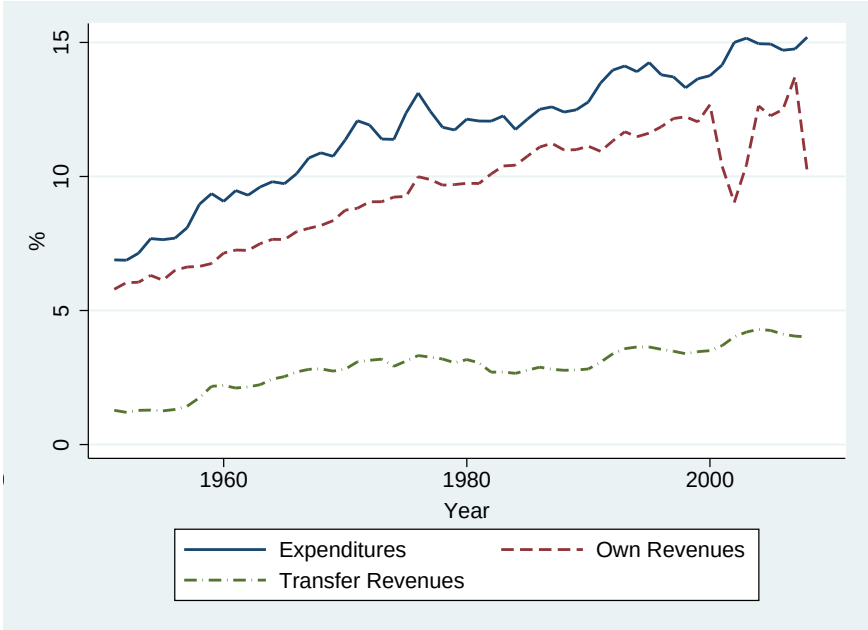


Figure 3: Fiscal Variables as Percent of Income

percentage of income ranges from a low of 6% to a high of 13%; and intergovernmental revenues as a percentage of income ranged from a low of 1.5% to a high of 5%. These trends illustrate that the rise in expenditures is more than can be explained by the increase in demand for public services brought about by the rising incomes (assuming public services are a normal good).

Figure 4 shows a scatter plot along with the best fit line between federal transfers and total expenditures and own revenues and total expenditures. Both show a strong positive relationship, and interestingly the slope of the fitted line for federal transfers is greater than that of own revenues reflective of the flypaper phenomenon. Of course this observation is potentially a result of the matching component of federal transfers which results in both a substitution and income effect, but when public welfare

transfers (including Medicaid, the largest matching grant program) were subtracted from total federal transfers the slope was still larger than own revenues.

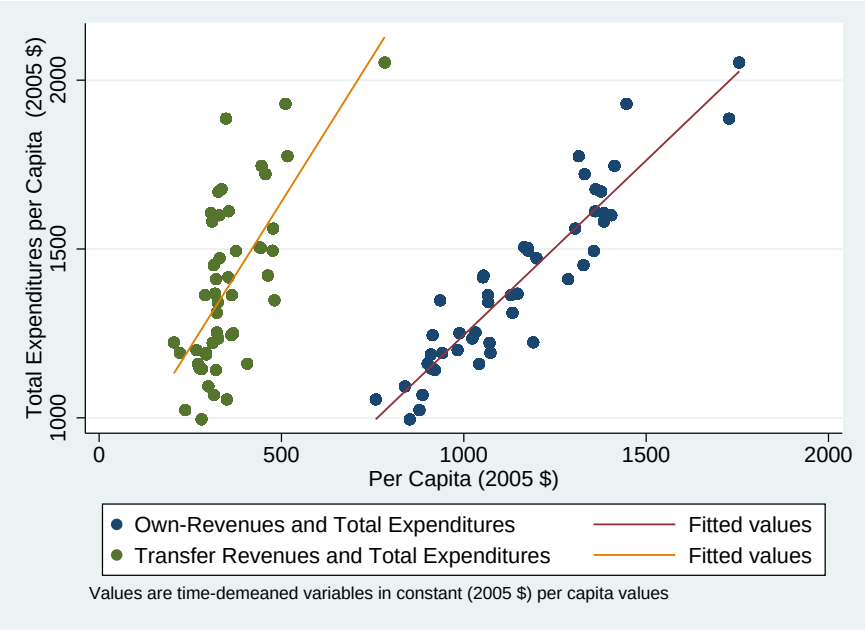


Figure 4: Relationship between Own Revenues and Federal Transfers and Total Expenditures

2.5 Cross-sectional Dependence

Recently, the concern over cross-sectional dependence has received a lot of attention among researchers (see Eberhardt & Bond, 2009). Cross-sectional correlation among US states can arise from a number of sources including common global shocks (e.g. changes in federal regulations, changes in federal fiscal policies, and federal transfer policies) which may have heterogeneous impacts across states. Alternatively, cross-sectional correlation can be a result of local spillover effects between states (see Moscone & Tosetti, 2009 for a survey and application of cross-sectional dependence tests). Failure to correct for cross-sectional dependence can lead to inefficiencies and biased standard errors in conventional estimators like OLS (Moscone & Tosetti, 2009). Furthermore, Andrews (2005) finds that OLS is inconsistent and the t-statistics are no longer asymptotically normal in the presence of cross-sectional dependence resulting from global shocks. Conceivably, failure to account for cross-sectional could provide an overestimate of the stimulative effect of grants on expenditures, which is commonly found in the literature. This is especially true since one of the functions of grants is to internalize interstate spillovers. Therefore, a significant contribution to the literature is checking the robustness of previous findings while accounting for cross-sectional correlations across states.

To account for cross-section dependence Pesaran (2004) suggests to use cross-sectional averages of the variables. To this end, cross-sectional averages are sub-

tracted from each variable to dilute the effects of cross-sectional dependence on model estimators. Table 3 provides the cross-sectional correlation before controlling for cross-sectional dependence (column 1) and after subtracting cross-sectional averages from each variable (column 2). Before controlling for cross-sectional dependence, cross-sectional correlation is very high for each variable, but after controlling for cross-sectional dependence the correlations are close to zero. These tests reveal a significant amount of CSD with respect to each variable and thus the need to control for CSD in order to inhibit identification of model parameters.

Table 3: Cross-Sectional Correlations

	(1)	(2)
Expenditures	0.995	-0.001
Tax Revenues	0.992	0.016
Other Revenues	0.956	0.006
Income	0.999	0.012
Transfer Revenues	0.989	0.069
Transfer Expenditures	0.986	0.061

Notes: Values are per capita 2005 dollars. Column 1 is cross-sectional correlation without controlling for cross-sectional dependence and Column 2 is the cross-sectional correlations when cross-sectional averages were subtracted from each variable following the advice of Pesaran (2004).

Spatial dependence, a subset of cross-sectional dependence, is also of concern. Evidence of spatial dependence suggests that cross-sectional dependence is greater among states that are "neighbors," in which neighbors can be described in terms of geographic or economic measures. The following eight figures illustrate the spatial correlations among states. It is interesting to note that instead of state policies converging they are instead becoming more clustered with their contiguous neighbors. On the other hand, income's spatial patterns appears to be fairly consistent in both periods. Although both periods exhibit signs of spatial correlation it appears that the nature of the spatial correlation has changed between the two periods thus warranting a dynamic analysis of the spatial correlations among fiscal variables.

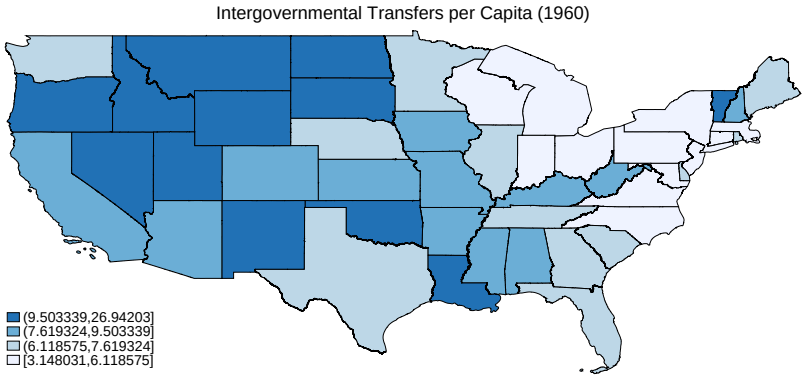


Figure 5: Spatial Relationships among Transfer Revenues in 1960

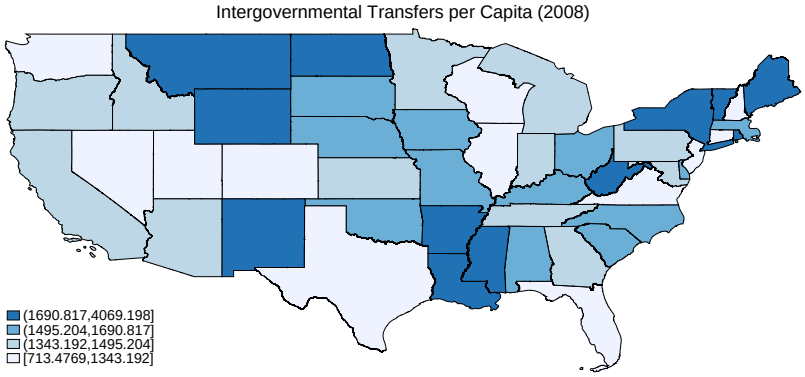


Figure 6: Spatial Relationships among Transfer Revenues in 2008

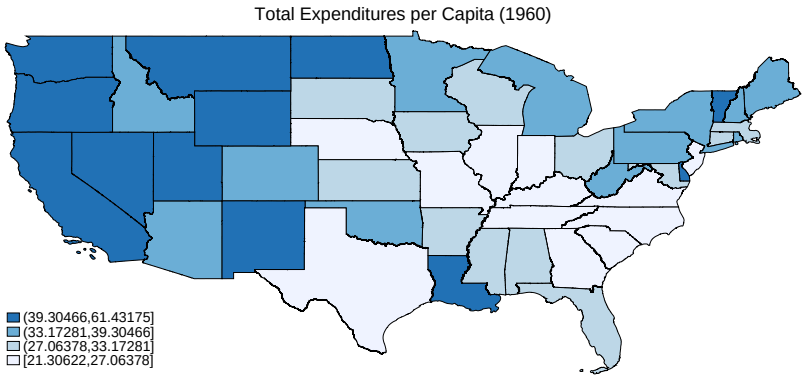


Figure 7: Spatial Relationships among Total Expenditures in 1960

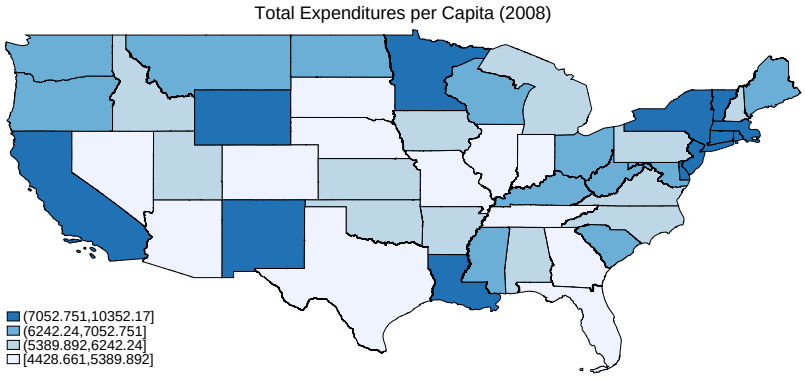


Figure 8: Spatial Relationships among Total Expenditures in 2008

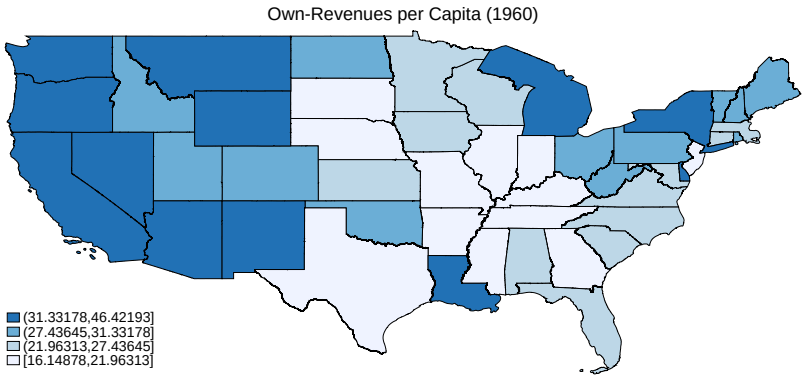


Figure 9: Spatial Relationships among Own Revenues in 1960

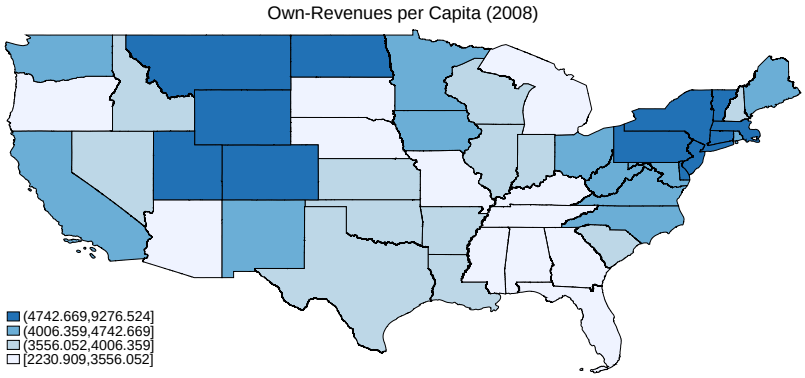


Figure 10: Spatial Relationships among Own Revenues in 2008

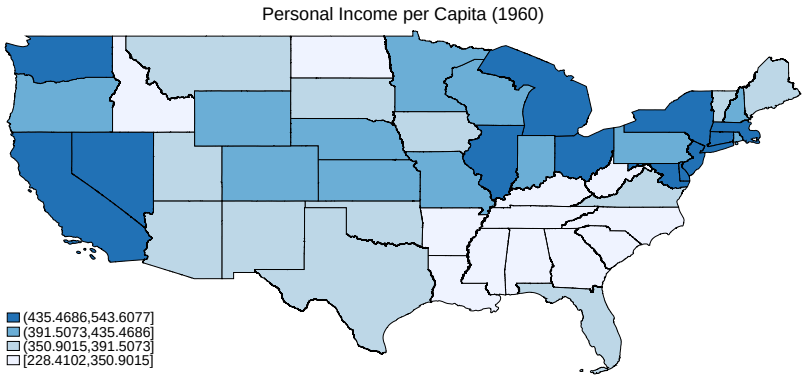


Figure 11: Spatial Relationships among Personal Income in 1960

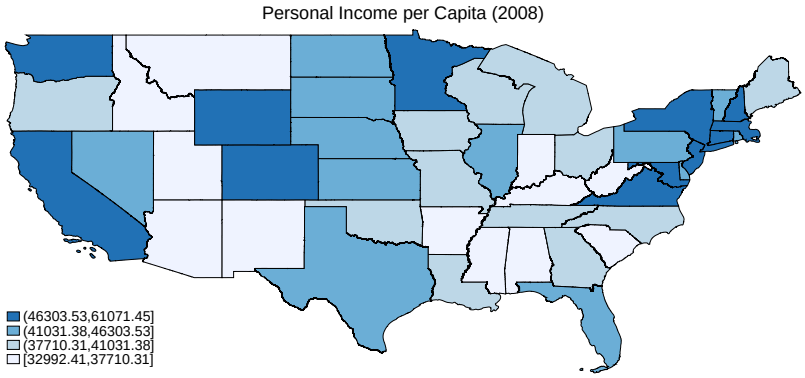


Figure 12: Spatial Relationships among Personal Income in 2008

2.6 Discussion of Spending and Revenue Trends

A look at the raw data reveal interesting patterns that warrant a more rigorous statistical analysis to unfold important fiscal relationships and adjustments over time. The first major observation is the large increase among fiscal variables (per capita and as a percent of income) including debt over time. State governments are directing a large fraction of economic resources, and thus understanding how these resources are being spent by state governments is imperative for understanding state based economic growth. Furthermore, based on the raw data it appears that states are relying more heavily on revenue sources other than taxes to finance expenditures and debt. To better understand these fiscal relationships and dynamic adjustments Chapter 4 provides a statistical analysis of the intertemporal budget constraint. Also, the close relationship between transfer revenues and transfer expenditures exhibited over time is suggestive that states are using transfer revenues to finance transfer expenditures, which is quite surprising given the different programs each are intended to fund. This idea is developed more thoroughly in Chapter 3.

The other major revelation from the preliminary analysis is the significant amount of cross-sectional dependence inherent in the data, which is typically ignored in the current literature. To this end, the remainder of this dissertation all the variables are demeaned using cross-sectional averages as suggested by Pesaran (2004). Furthermore, the spatial maps above indicate further cross-sectional dependence in the form of spatial dependence. To better understand these spatial correlations and their effect on state government spending behavior Chapter 5 employs developments in spatial econometrics to estimate spillovers from grants and expenditures in neighboring states and their effect on own-state fiscal policies.

3 Exploring the Dynamics of Intergovernmental Linkages: Is the State a Conduit for Funds?

3.1 Introduction

The growth in government spending and composition has changed substantially over the years. In large part, government spending has moved away from defense spending and towards social insurance programs. What is particularly pronounced is the increasing role of state spending, both as a percentage of gross domestic product and of total government spending. In particular, state spending has increased from fifteen percent of total government spending in 1960 to twenty-four percent in 2008. Moreover, intergovernmental transfers have significantly increased over the past five decades as shown in Figure 13. From the states' perspective–being a donor and recipient of transfers–both transfer revenues and transfer expenditures have increased substantially since the late 1960's. Furthermore, the relationship between these two series remains remarkably synchronized over time.

In association with Musgrave's (1959) allocative branch of the public sector, fiscal resources are being devolved to state and local governments at an ever increasing rate. Of course this devolution of spending responsibilities to state and local governments can be efficiency enhancing as described by Oates' (1972) Decentralization Theorem that states that non-uniform provision of public goods provided by local-level governments is more efficient than a uniform provision of public goods provided by more centralized governments, since local-level governments are in a better position to match local benefits with local costs. As noted by Oates (1999), "provision of public services should be located at the lowest level of government encompassing, in a spatial sense, the relevant benefits and costs." In addition, Tiebout (1956) showed that individuals will sort themselves across heterogeneous jurisdictions according to their preferences. Therefore, the option to "vote with ones' feet" enables preference revelation with respect to public goods that is efficiency enhancing.[2]

However, efficiency gains provided by decentralization can be diminished by the externality nature of many public goods that induce spillover benefits to neighboring jurisdictions (see Chapter 5 for more on externalities in fiscal federalism).[3] Of course, in the presence of inter-state externalities the federal government can choose to provide the public good directly (e.g. national defense) or they may choose to internalize the spillover through the use of intergovernmental transfers. In fact, one of the four distinct roles served by the national government, according to Baicker *et al.* (2010), involve structuring intergovernmental transfers to correct interstate spillovers. This role is of particular interest as states and the federal government use intergovernmental transfers to encourage (or discourage) spending by lower level governments. Among the most common state-level expenditures that potentially exhibit externalities and are among the highest recipients of government grants include, education,

[2]For an extensive survey of the consistency of the current empirical literature with the Tiebout model consult Baicker *et al.* (2010).

[3]Using US state-level data, Case (1993) finds significant evidence of interstate spillovers.

health and hospital, highway, and public welfare.

Interestingly, as noted by Wildasin (2010), despite the disparate programs financed by federal and state transfers, there exists a surprisingly stable relationship between federal-to-state transfers and state-to-local transfers as shown in Figure 14. This proportion, aside from pre-1960, has never dropped below 60% and even steadily approaches 100% in the late 2000's. Even more astonishing is the persistence of this relationship against a backdrop of an ever changing political, economic, and demographic environment. Over this period the US has been through multiple wars, twelve presidents with varying political ideologies, multiple business cycles, technological advancements, and the aging "baby boomer" generation, to name a few.

This persistent stable nexus between federal-to-state transfers and state-to-local transfers, as observed by Wildasin (2010), brings forth the question: do states act as a "conduit" for funds from the federal government to local governments? Figure 15 illustrates the potential channels through which federal aid can be allocated. As shown, federal aid can be used by the state government to: (1) increase state spending on own sources (channel 1); (2) increase aid expenditures to local governments (channel 2) and (3) cut own revenues (e.g. tax cuts) (channel 3). The conduit hypothesis concerns itself with the second channel in which federal aid is funneled to local governments in the form of transfer expenditures. This question is of interest as federal-to-state transfers serve very disparate programs compared to state-to-local transfers. For example, the largest federal-to-state grant category is assigned to public welfare (which includes Medicaid), whereas the largest state-to-local grant category is devoted to education. Consequently, resources directed towards public welfare spending could potentially be captured by the state and diverted towards education in the form of transfer aid to local governments. To further motivate this idea, Figure 16 displays the time-series plots of the largest transfer revenue category (i.e. public welfare) and largest transfer expenditure category (i.e. education). Although these two transfer categories are inherently unrelated, they follow a strikingly synchronized relationship that persists over time.

Recently, the US has moved away from matching grants and toward block grants for such programs as welfare. For example, the Welfare Reform Act of 1996 converted the welfare program titled Aid to Families with Dependent Children (AFDC) from a matching grant to a block grant program titled Temporary Assistance to Needy Families (TANF). This switch gave states considerable more autonomy in their welfare spending. Conceivably, the initiation of this program could potentially exacerbate the issue of resource diversion away from welfare and towards other expenditure categories if the interests of the federal government and state government do not fully align. Decentralized governments, such as state governments, also have an incentive to provide benefit levels less than neighboring states to prevent migration of welfare recipients into the state. For instance, there is an extensive literature on competition among states which incentivize states to divert spending away from non-competitive resources and towards competitive resources (e.g. to encourage or discourage mobility

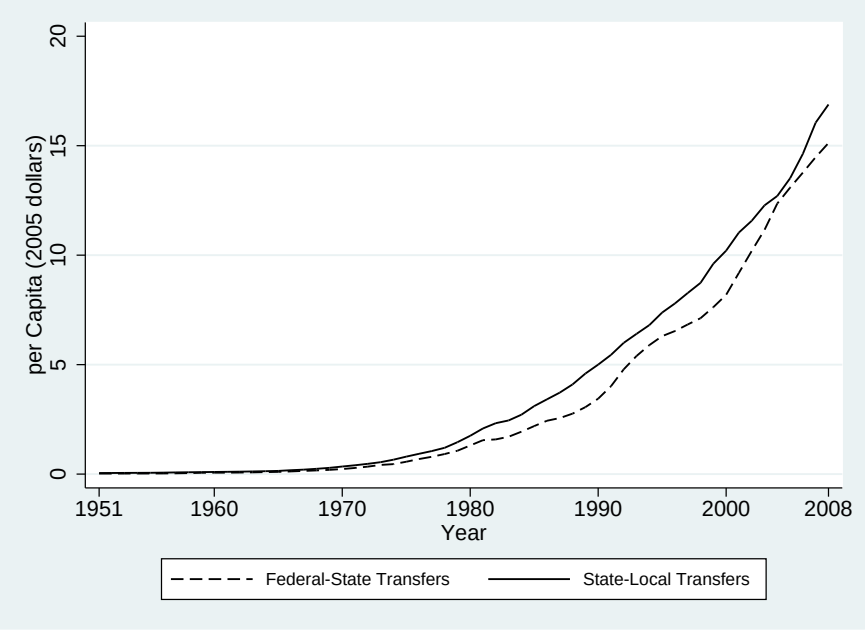


Figure 13: Federal and State Transfers

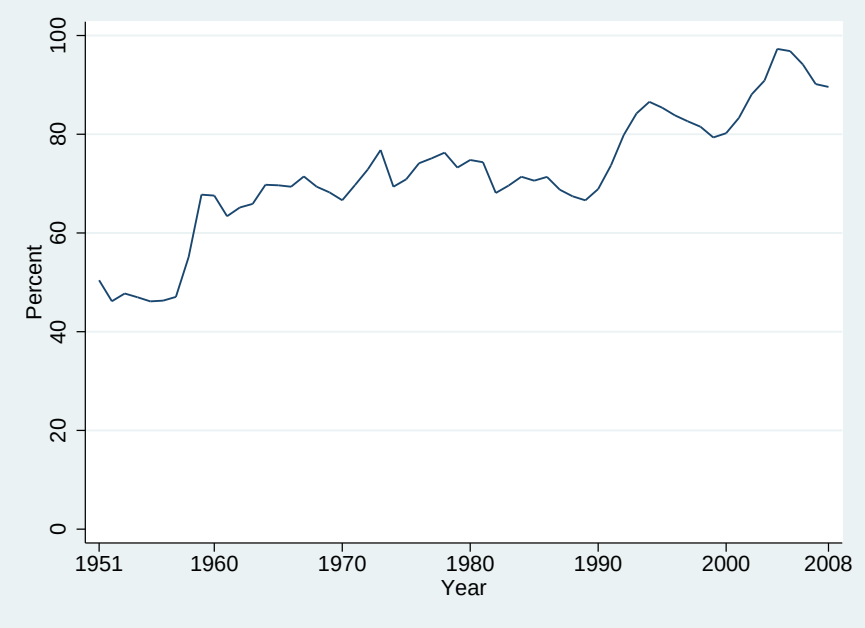


Figure 14: State Transfers as a Percent of Federal Transfers

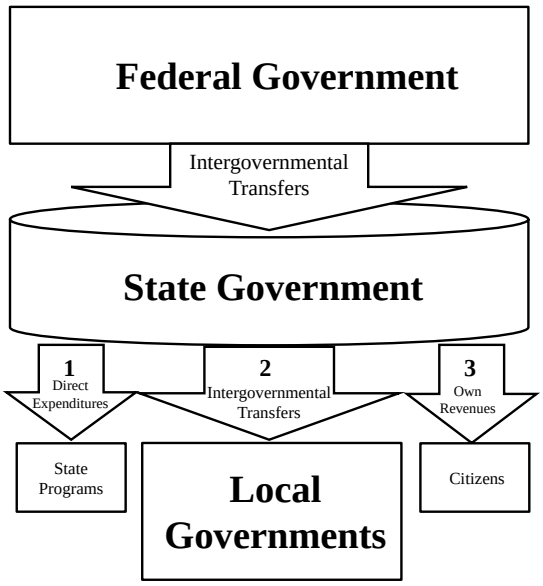


Figure 15: The Conduit Hypothesis

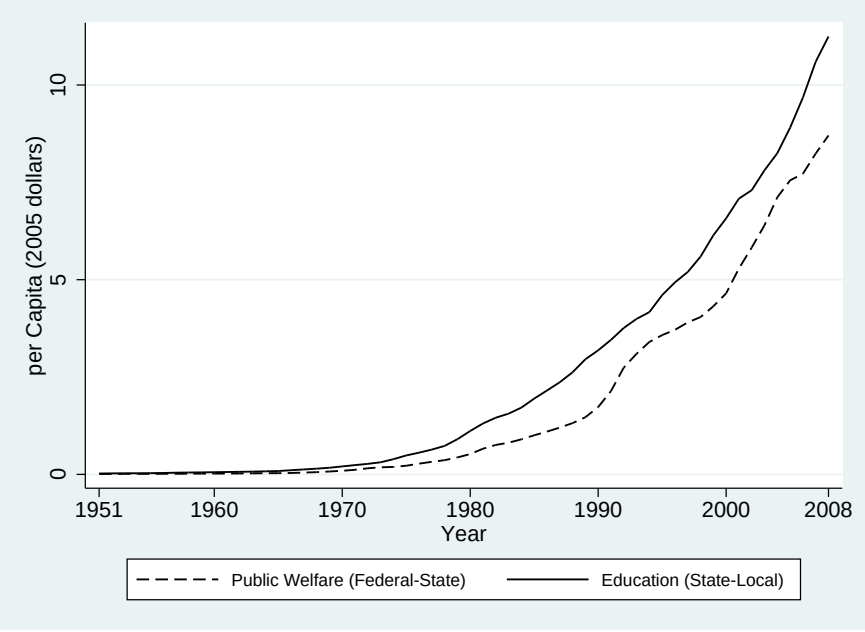


Figure 16: Public Welfare Transfer Revenues and Education Transfer Expenditures

of certain residents).[4]

This brief look at the relationship between transfer revenues and transfer expenditures motivates a more rigorous analysis to uncover the underlying relationship between transfer revenues and transfer expenditures. Knowing how lower level governments spend transfers, as discussed by Inman (2008), helps in the design of more efficient government transfer policies; and in understanding how governments spend citizens' income provides valuable insight into how citizen preferences are being represented by government. As opposed to the current literature, which looks at the stimulative effect of total transfers on total expenditures at the state and local levels, this study examines the extent to which federal aid to states is spent on aid to local governments. The substantial amount of autonomy afforded to local governments in their taxation, expenditures and borrowing (see Wildasin, 2008) offer another channel for fiscal resources to be mis-directed, thus further distorting the final funding destination of federal aid. Furthermore, answering this question exposes a deeper understanding of the flypaper effect as it applies to federal aid spent on aid to local governments. Recent developments in non-stationary panel time-series techniques allow for exploiting the underlying dynamic relationships while allowing for heterogeneous state responses to federal aid, which provide further insight into the relationship between aid to states and aid to local governments that assists in the proper design and implementation of transfers.

3.1.1 The Conduit Hypothesis

Transfers link all levels of government within a federalist system. The state is a special case as they are a recipient of grants from the federal government and donor of grants to local governments. The position of the state government, between a centralized government and many decentralized local governments, allows it to better align incentives and reduce transaction costs.[5] Presumably, state governments have more knowledge concerning the demands of the median voter, either directly or indirectly through local governments, for which they could increase efficiency through their autonomy in allocating federal grants to its own expenditures or by funneling these funds down to local governments to internalize local spillovers and satisfy the demands of the median voter. Furthermore, it is conceivable that state governments possess more knowledge, relative to the central government, of the local benefits and costs associated with public services (Oates, 2005). This observation warrants an analysis of the degree to which states, instead of using grants to fund its own projects, funnel the grants to local governments. It is imperative to disaggregate the response of own expenditures and aid expenditures since funneling federal aid to local

[4]With respect to fiscal competition, mobility of resources is of particular interest. For example, Baicker (2005) shows that mobility is the best predictor of interstate interaction and Hoyt (1993) shows that the mobility of residents affects the outcomes of tax and expenditure competition. For an extensive review of the empirical evidence of fiscal competition see Brueckner (2003).

[5]See Oates (2005) for an extensive review of the literature on Second Generation Theory of Fiscal Federalism.

governments provides another avenue for resource diversion.[6] The conduit hypothesis is closely related to the flypaper effect. In fact, the conduit hypothesis corresponds to a flypaper effect with respect to transfer revenues stimulating transfer expenditures greater than a pure income effect. In what follows, a closer investigation of the flypaper effect is given to ascertain the allocation of transfers through various potential channels of distribution. For instance, is federal aid used to stimulate direct spending (or tax cuts) or instead being funneled to local governments in the form of aid expenditures? Differentiating the stimulative effect on direct spending and spending on aid to local governments is necessary since federal aid funneled through the states allow autonomous local governments to determine the final use of federal resources.

Previous studies of the fungibility of intergovernmental transfers and the flypaper effect certainly raise the possibility that aid to state governments, for whatever ostensible purpose, may in the end be spent wholly or partially in the form of transfers to local governments. Consistent with the "flypaper" notion, such a use of federal assistance to states would suggest that "money that originates in the public sector stays in the public sector", even as, consistent with the principle of fungibility, that assistance might ultimately support public purposes far removed from those of the programs through which states receive fiscal transfers. The goal of the present study is to investigate this "conduit" hypothesis, ascertaining the impact of federal aid to states on state assistance to localities. Using disaggregated data, it is possible to study not only the total impact of federal aid on local government revenues, but to determine, by state, and by source of federal funds (such as welfare or Medicaid) the impact of such aid on specific categories of state assistance to localities for such purposes as education or highways.

The chapter proceeds as follows: Section 3.2 constructs the error correction model using the partial adjustment mechanism; Section 3.3 discusses the data, methodology and results, which include short-run and long-run estimates, an analysis of the flypaper effect, and impulse response functions; Section 3.4 provides a discussion of the results; and concluding remarks are given in Section 3.5.

3.2 Partial Adjustment and Error Correction Model

To guide the construction for the long-run model, both theory and previous empirical findings were used in the selection of the variables and beyond that, parsimony and ease of interpretation were considered.[7] The long-run model is based on a simplified version of Black's (1948) Median Voter model in which the state government maximizes the utility of the median voter subject to the median voter's full income (i.e. personal income and the median voter's share of the intergovernmental grants from the federal government). The assumption in the model here is that the median voter

[6] A related and equally important question relates to how the local governments use these grants. Conceivably, local governments can then further divert resources. This question is beyond the scope of this paper and a topic for further inquiry.

[7] While determining the response of a change in federal aid it's important to note that certain programs will elicit price and income effects, but for purpose here the only interest is in the overall effect.

demands a certain amount of spending resources to be devolved to local governments. According to Oates (1985), in reference to a discussion with the American economic historian John Wallis, individuals have more control over public decisions made at the local level and thus will demand a wider range of functions and responsibilities at localized governments as opposes to state and national governments. Therefore, the following model is a linear stochastic equation of the Median voter's demand for local government aid (in expenditure form):

$$E_{it}^{*} = a_i + \beta_1 G_{it} + \beta_2 I_{it} + \beta_3 EX_{it} + \gamma X_{it} + \epsilon_{it} \tag{1}$$

where i and t index state and time, respectively. E_{it}^{*} is desired level of intergovernmental expenditures from the median voter perspective; G_{it} include intergovernmental transfers from the federal government; I_{it} represents personal income; EX_{it} is residual expenditures, which is assumed to serve as a substitute for transfer expenditures; and X_{it} is a vector of control variables that are important shifters of the median voter's demand curve, and include the unemployment rate, population density and dependency ratio. The parameters β_1 and β_2 represents the long-run impact of changes in federal aid and income on transfer expenditures. Therefore, β_1 represents the marginal propensity to spend federal aid on aid to local governments, thus providing an estimate of the state's propensity to serve as a conduit for funds. The long-run depends on factors such as resource fungibility, state autonomy, and changes in the environment relating to demographics, economics, and politics.

In order to make equation (1) operational the partial adjustment mechanism is used. The partial adjustment mechanism is defined as:

$$E_{it} - E_{it-1} = \lambda(E_{it}^{*} - E_{it-1}) \tag{2}$$

where the left hand side represents the actual change in expenditures and the right hand side represents desired change in expenditures. The parameter, $0 \leq \lambda \leq 1$, is the coefficient of adjustment. When $\lambda = 1$ the adjustment from E_{it-1} to E_{it} is instantaneous and when $\lambda = 0$ there is no adjustment. Solving equation (2) for E_{it}^{*} gives:

$$E_{it}^{*} = \frac{1}{\lambda} E_{it} - \frac{1-\lambda}{\lambda} E_{it-1} \tag{3}$$

Substituting equation (3) into equation (1) (ignoring control variables) yields:

$$E_{it} = \lambda a_i + (1-\lambda) E_{it-1} + \lambda\beta_1 G_{it} + \lambda\beta_2 I_{it} + \lambda\beta_3 EX_{it} + \lambda\epsilon_{it} \tag{4}$$

where the short-run multipliers are $b_1 = \lambda\beta_1$, $b_2 = \lambda\beta_2$ and $b_3 = \lambda\beta_2$ and the long-run multipliers are $\beta_1 = \frac{b_1}{\lambda}$, $\beta_2 = \frac{b_2}{\lambda}$ and $\beta_3 = \frac{b_3}{\lambda}$. Subtracting E_{it-1} from both sides of

(4) yields:

$$\Delta E_{it} = \lambda a_i + \lambda E_{it-1} + \lambda \beta_1 G_{it} + \lambda \beta_2 I_{it} + \lambda \beta_3 EX_{it} + \lambda \epsilon_{it} \tag{5}$$

then adding and subtracting $\lambda\beta_1 G_{it}$, $\lambda\beta_2 I_{it}$, and $\lambda\beta_3 EX_{it}$ equation (5) can be re-written as:

$$\Delta E_{it} = \lambda a_i + b_1 \Delta G_{it} + b_2 \Delta I_{it} + b_3 \Delta EX_{it} + \lambda(E_{it-1} + \beta_1 G_{it-1} + \beta_2 I_{it-1} + \beta_3 EX_{it}) + \lambda \epsilon_{it} \tag{6}$$

Equation (3.6) is the error correction representation of equation (1). The short-run multipliers are given by b_1 through b_3 and the parameters β_1 through β_3 represent long-run multipliers. Both b_1 and β_1 measure the degree of pass-through from federal aid to aid to local governments. Finally, the coefficient of adjustment, λ, provides a measure of the adjustment to long-run equilibrium.

3.3 Empirical Section

3.3.1 Data

The variables used in this chapter include residual expenditures (i.e. intergovernmental expenditures to local governments subtracted from total expenditures), intergovernmental expenditures to local governments (local aid) and intergovernmental revenue from the federal government (federal aid). These two intergovernmental transfer series are then disaggregated into public welfare, highway, health and hospital and education in order to examine the relationship among the diverse aid categories.[8] All variables are in per capita constant 2005 dollars. Other control variables include population density, unemployment rate, and the dependency ratio, which are understood to be important determinants of state-level spending. Table 4 provides the summary statistics for each variable (in per capita constant 2005 dollars) under consideration. Notice the similarities between the mean of transfer revenues and the mean of transfer expenditures. Also note that public welfare is the largest transfer revenue category and education is the largest transfer expenditure category, whereas health and hospital is the smallest for both.

To proceed in examining the underlying dynamic relationship between transfer revenues and transfer expenditures, the next section explores the long-run cointegrating relationship among the variables in equation (1).

3.3.2 Aggregate Sample

Cointegration Analysis

Prior to estimation the variables must be stationary, therefore the Fisher-type tests by Choi (2001), Breitung (2000) and the Im *et al.* (2003) are used to test for

[8]Census definitions of each can be found in Appendix A.

Table 4: Summary Statistics

	Mean	Standard Deviation
Aggregates		
Own Expenditures	1033.31	1351.00
Own Revenues	1143.15	1474.16
Transfer Revenues	356.83	500.99
Transfer Expenditures	359.85	472.85
Personal Income	10124.60	12147.70
Disaggregated Intergovernmental Revenues		
Education	60.12	82.18
Highway	42.51	58.67
Health and Hospital	18.35	30.51
Public Welfare	181.64	270.48
Disaggregated Intergovernmental Expenditures		
Education	249.17	325.97
Highway	17.52	26.73
Health and Hospital	10.41	25.48
Public Welfare	22.58	65.57
Disaggregated Own Expenditures		
Education	198.37	257.81
Highway	99.68	123.82
Health and Hospital	78.76	106.37
Public Welfare	263.25	388.69
Residual Expenditures	1033.31	1351.00

Notes: Values are per capita 2005 dollars.

unit roots (see Appendix B for details). According to these tests the variables are all integrated to order one in levels and stationary in first differences. Given this fact, in conjunction with the synchronized relationship between transfer revenues and transfer expenditures as shown in Figures 13 and 16, it's possible there exists a long-run relationship among these variables. In other words, it is possible that a linear combination of the non-stationary variables may be stationary and thus cointegrated. Indeed, theory predicts a cointegrated relationship among federal aid, personal income, and state expenditures as described by the median voter demand equation. Stationarity of the error term, ϵ_{it}, is a necessary condition for equation (1) to represent a long-run relationship.[9] According to the Pedroni's (2000) residual-based cointegration tests the equations are indeed cointegrating (see Appendix C for details). Evidence of cointegration is indicative of a long-run relationship among the variables which can be represented by the simplified median voter's demand equation (1) rewritten here.

$$E_{it} = \alpha_i + \beta_1 G_{it} + \beta_2 I_{it} + \beta_3 EX_{it} + \gamma X_{it} + \epsilon_{it} \tag{7}$$

The parameter β_1, β_2, β_3 and γ represent the cointegrating vectors, where the parameter β_1 provides a measure of long-run pass-through from federal aid to local governments. [10]

A necessary and sufficient condition for the conduit effect is evidence of flypaper behavior with respect to the stimulative effect of transfer revenues on transfer expenditures. In other words, rejection of the equivalence theorem ($\beta_1 = \beta_2$) suggests that federal aid stimulate aid to local governments more than can be explained by a pure income effect, therefore favoring the conduit hypothesis. The conduit effect can be broken down into the "strong" and "weak" form. The strong form of the conduit effect can by tested by the restriction, $\beta_1 = 1$ meaning complete pass-through of federal aid to local governments. The weak form allows for incomplete pass-through and is tested by the restriction $1 > \beta_1 > \beta_2$.

Long-run Estimates

Given significant evidence in favor of cointegration, the long-run equation (7) is estimated using a number of methods: (1) Least Squares Dummy Variables (LSDV)(2) Dynamic OLS (DOLS) of Kao & Chiang (2000) and Chiang & Kao (2002); (3) Two-Stage Least Squares (2SLS): and (4) Pooled Mean Group (PMG) of Pesaran *et al.* (1999). Cointegrated relationships have the nice feature of super consistency, therefore LSDV is used to estimate the cointegration vectors; however, these estimates suffer from an asymptotic bias making the standard errors invalid. Using Monte Carlo simulations Kao & Chiang (2000) show that fully modified OLS (FMOLS) does not improve on OLS and DOLS outperforms FMOLS in small samples. DOLS is estimated by augmenting the cointegrating equation (7) with lags and leads of the

[9] Of course, evidence in favor of cointegration could also mean there is a third factor not accounted for that is driving the cointegration.

[10] The use of control variables substantially limits the number of observations and are therefore used only as a robustness check.

first differenced regressors, which capture the dynamics around the equilibrium and circumvents problems associated with endogenous feedback and serial correlation.

Recent attention has been focused on the endogeneity of grants and the correction thereof (see, e.g., Knight, 2002). Although DOLS remains robust in the presence of endogeneity it does not correct for it. To correct for the possible endogeneity of grants 2SLS is used. Given the lack of "good" instruments, lags of transfer revenues are used as instruments. For this estimation technique the Hansen J test for overidentifying restrictions is reported to ensure the moment conditions are satisfied and the instruments are valid. Finally, the PMG estimator developed by Pesaran *et al.* (1999) estimates the error correction representation of the cointegrating equation and constructs the cointegrating vectors from the short-run coefficient estimates using maximum likelihood. The PMG estimator allows the short-run dynamics, adjustment coefficients, and error variances to vary across groups while constraining the long-run coefficients to be equal across groups. Therefore, the PMG estimators permits investigation of the homogeneous long-run coefficients without imposing homogeneity in the short run.

Panel A of Table 5 provide the resulting estimates of the cointegrating vectors using each estimation technique. Columns 1-4 give the resulting cointegrating vectors excluding the control variables. Columns 1 uses LSDV to estimate the cointegrating vectors with an estimated pass-through of 0.50; however, given that this estimate is potentially biased, Columns 2-4 use techniques that are more robust. Dynamic OLS, in Column 2, shows a pass-through estimate of 0.604, which is surprisingly close to the 2SLS estimate of 0.606 in Column 3. This finding supports the robustness of DOLS in the presence of endogeneity. Column 4 reports the cointegrating vectors using the PMG estimator. This method shows a much higher estimate for the conduit effect with a magnitude of 0.80. The coefficient associated with income falls in the range of 0.01-0.03 and is significantly smaller than each coefficient associated with federal aid. Also, the coefficient on residual expenditures is negative suggestive of the substitutability between direct expenditures and intergovernmental expenditures. Specifications in Columns 5-8 include the control variables. Although smaller, the estimates confirm the findings in columns1-4.[11] Tests of the conduit hypothesis in Panel B reject the strong form of the conduit effect, but also reject the equivalence theorem for each specification, thus yielding in favor of the weak form of the conduit effect and the incomplete pass-through of federal aid to local governments.

Table 6 provides cointegrating estimates by state using 2SLS. The results show a total of fifteen states supporting the conduit hypothesis. Of the fifteen states, nine states support the complete pass-through of federal transfers (FL, ME, MD, MA, NY, UT, WA, WV) and the other six support incomplete pass-through (CT, IL, MI, MS, PA, MN). However, with only fifty-three observations caution should be given to concluding anything from these estimates. One thing of particular interest and perhaps deserves more attention is that of the fifteen states that support the conduit

[11] Appendix D reports the cointegration estimates when own revenues are the dependent variables. The results suggest a complementarity between own revenues and intergovernmental revenues, which is consistent with the findings of Stine (1994)

Table 5: Estimates of Long-Run Pass-Through

Panel A: Estimates for Cointegrating Vectors								
Variables	(1) Fixed Effects	(2) Dynamic OLS	(3) 2SLS	(4) PMG	(5) Fixed Effects	(6) Dynamic OLS	(7) 2SLS	(8) PMG
Grants	0.495***	0.604***	0.606***	0.801***	0.377***	0.493***	0.525***	0.756***
	(0.021)	(0.004)	(0.057)	(0.051)	(0.027)	(0.058)	(0.063)	(0.063)
Income	0.024***	0.034***	0.027***	0.013***	0.026***	0.033***	0.028***	-0.016***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.002)	(0.006)	(0.004)	(0.002)
Residual Expenditures	-0.093***	-0.139***	-0.133***	-0.149***	-0.029*	-0.030	-0.086***	0.116***
	(0.012)	(0.028)	(0.026)	(0.023)	(0.016)	(0.038)	(0.030)	(0.020)
Unemployment Rate					-0.000	0.000***	-0.000	0.000***
					(0.000)	(0.000)	(0.000)	(0.000)
Dependency Ratio					1,032.042***	50.266	1,156.523***	-1,254.751***
					(203.841)	(418.882)	(195.522)	(134.796)
Population Density					-1,800.948***	-275.839	-1,453.099***	42.482
					(228.597)	(586.891)	(229.344)	(172.502)
Hansen J Statistic			1.671				1.302	
			[0.643]				[0.729]	
Observations	2,784	2,784	2,784	2,640	1,584	1,584	1,584	1,440
Number of States	48	48	48	48	48	48	48	48
Panel B: Tests of the Conduit Hypothesis								
H-0: $\beta_1 = \beta_2$	520.4***	13.69***	111.6***	259.6***	170.6***	7.99***	64.88***	154.6***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
H-0: $\beta_1 = 1$	567.4***	-6.95***	48.25***	15.40***	527.5***	-8.74***	56.05***	15.00***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Notes: t-stats are in parentheses. For DOLS estimates one lag and lead of the differenced regressors are included in each regression. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

hypothesis, only one of them is a republican state (UT) (based on the average margins of victory for presidential elections from 1992 to 2008)[12] and two were swing states (FL and WV).

[12]These calculations were based off estimates from Wikipedia.

Table 6: Cointegration Estimates by State

State	Grants		Income		Residual Expenditures		$\beta_1 = \beta_2$		$\beta_1 = 1$	
AL	-0.205	(0.646)	0.055**	(0.024)	-0.301	(0.366)	0.173	[0.677]	3.483	[0.062]
AZ	-0.145	(0.103)	0.015	(0.017)	-0.123*	(0.064)	2.481	[0.115]	122.9	[0.000]
AR	-6.142**	(3.087)	-0.135**	(0.057)	1.600***	(0.597)	3.927	[0.048]	5.354	[0.021]
CA	-0.167	(0.504)	0.200***	(0.023)	-0.322	(0.272)	0.575	[0.448]	5.351	[0.021]
CO	-0.015	(0.128)	-0.029***	(0.004)	0.056	(0.068)	0.0131	[0.909]	63.26	[0.000]
CT	0.495***	(0.183)	-0.008	(0.008)	-0.004	(0.090)	8.183	[0.004]	7.594	[0.006]
DE	-0.232	(0.255)	-0.037***	(0.011)	-0.006	(0.022)	0.571	[0.45]	23.33	[0.000]
FL	1.744***	(0.490)	0.041	(0.026)	-0.404**	(0.196)	12.28	[0.000]	2.311	[0.128]
GA	-0.367**	(0.183)	0.024**	(0.009)	0.278***	(0.059)	4.736	[0.030]	56.01	[0.000]
ID	0.154	(0.451)	-0.006	(0.012)	0.168	(0.176)	0.126	[0.722]	3.52	[0.061]
IL	0.601**	(0.301)	-0.020*	(0.012)	-0.21	(0.223)	4.178	[0.041]	1.753	[0.186]
IN	-0.713	(0.637)	0.067***	(0.012)	0.036	(0.229)	1.512	[0.219]	7.241	[0.007]
IA	-0.612*	(0.366)	0.041**	(0.017)	-0.048	(0.095)	2.937	[0.087]	19.36	[0.000]
KS	-0.389	(0.274)	-0.029	(0.033)	0.171*	(0.090)	1.542	[0.214]	25.63	[0.000]
KY	0.387	(0.466)	0.039***	(0.003)	-0.229***	(0.042)	0.563	[0.453]	1.73	[0.188]
LA	0.79	(1.176)	0.087	(0.067)	-0.719	(1.095)	0.4	[0.527]	0.032	[0.858]
ME	0.850***	(0.300)	0.037***	(0.013)	-0.702***	(0.128)	7.356	[0.007]	0.248	[0.618]
MD	0.852***	(0.313)	0.008	(0.010)	0.091	(0.234)	7.736	[0.005]	0.223	[0.637]
MA	1.182***	(0.360)	0.082**	(0.033)	-0.729***	(0.267)	11.11	[0.001]	0.256	[0.613]
MI	5.416***	(1.993)	0.046	(0.048)	-2.824***	(0.431)	6.985	[0.008]	4.91	[0.027]
MN	0.672**	(0.298)	0.207***	(0.016)	-0.636***	(0.150)	2.673	[0.102]	1.211	[0.271]
MS	0.289***	(0.090)	0	(0.007)	-0.045	(0.103)	12.19	[0.000]	62.91	[0.000]
MO	0.157	(0.206)	0.119***	(0.009)	0.134***	(0.035)	0.0335	[0.855]	16.81	[0.000]
MT	-0.235*	(0.127)	0.007	(0.015)	-0.011	(0.142)	4.205	[0.040]	95.21	[0.000]
NE	-1.431**	(0.612)	0.139***	(0.050)	0.635***	(0.107)	5.867	[0.015]	15.79	[0.000]
NV	-0.247*	(0.131)	0.037***	(0.007)	0.141***	(0.053)	5.191	[0.023]	90.32	[0.000]
NH	1.139	(0.864)	-0.081**	(0.032)	-1.017***	(0.220)	2.138	[0.144]	0.0259	[0.872]
NJ	2.366***	(0.610)	0.018*	(0.010)	0.282**	(0.110)	15.23	[0.0001]	5.025	[0.025]
NM	0.059	(0.536)	-0.048***	(0.011)	0.27	(0.253)	0.0401	[0.841]	3.078	[0.079]
NY	1.331**	(0.621)	0.085**	(0.040)	-0.449	(0.583)	4.441	[0.035]	0.284	[0.594]
NC	1.737	(3.362)	0.087***	(0.033)	-0.611	(0.607)	0.245	[0.620]	0.0481	[0.826]
ND	-1.047***	(0.207)	-0.032**	(0.014)	0.330**	(0.130)	25.55	[0.000]	97.82	[0.000]
OH	-1.386***	(0.197)	-0.025**	(0.010)	0.261	(0.186)	46.14	[0.000]	146.1	[0.000]
OK	-0.806***	(0.188)	0.053***	(0.009)	0.1	(0.089)	20.56	[0.000]	92.38	[0.000]
OR	-0.059	(0.172)	0.012	(0.022)	0.290***	(0.107)	0.138	[0.71]	37.95	[0.000]
PA	0.359**	(0.171)	-0.048***	(0.017)	-0.303***	(0.080)	6.546	[0.011]	14.12	[0.000]
RI	1.119	(0.798)	-0.091	(0.076)	-0.419***	(0.162)	2.055	[0.152]	0.0221	[0.882]
SC	-0.377	(0.325)	0.047***	(0.009)	0.13	(0.114)	1.635	[0.201]	17.95	[0.000]
SD	-0.508*	(0.300)	0.042***	(0.015)	0.811***	(0.069)	3.632	[0.057]	25.26	[0.000]
TN	-0.304***	(0.104)	0.048***	(0.016)	0.244***	(0.048)	9.513	[0.002]	156.5	[0.000]
TX	0.566	(1.142)	0.022	(0.029)	0.217	(0.318)	0.236	[0.627]	0.145	[0.704]
UT	0.963***	(0.131)	0.011**	(0.005)	0.026	(0.068)	49.81	[0.000]	0.0802	[0.777]
VT	0.664	(0.629)	0.425***	(0.055)	0.247	(0.287)	0.151	[0.698]	0.285	[0.593]
VA	-0.202	(0.218)	0.008	(0.019)	0.257	(0.195)	0.988	[0.32]	30.51	[0.000]
WA	0.794**	(0.327)	0.025	(0.036)	0.207	(0.132)	6.947	[0.008]	0.4	[0.527]
WV	0.558*	(0.297)	0.043***	(0.012)	-0.194***	(0.065)	3.258	[0.071]	2.216	[0.137]
WI	-1.848***	(0.345)	0.378***	(0.059)	-0.413*	(0.223)	32.34	[0.000]	68.19	[0.000]
WY	0.359	(0.314)	-0.015	(0.011)	0.57	(0.476)	1.449	[0.229]	4.17	[0.041]

Notes: Each state has 53 observations. Robust standard errors using the Huber-White sandwich estimator are in parentheses and probability values are in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

Panel Error Correction model

Given estimates of the cointegrating model, the panel error correction model of equation (3.6) is estimated using the panel analogue of the Engle & Granger (1987) two-step method by first estimating the long-run model specified in equation (7) in order to obtain the estimated residuals and then incorporating the lagged predicted residuals as an additional regressor into the error correction model to capture adjustment to long-run disequilibria. Therefore equation (3.6) can be generalized into the following error correction model:

$$\begin{aligned}\Delta E_{it} = &\sum_{k=1}^{n} a_{i,1,t-k}\Delta E_{it-k} + \sum_{k=0}^{n} b_{i,1,t-k}\Delta G_{it-k} + \sum_{k=0}^{n} b_{i,2,t-k}\Delta I_{it-k} + \\ &\sum_{k=0}^{n} b_{i,3,t-k}\Delta EX_{it-k} + \lambda_i \widehat{\epsilon}_{it-1} + u_{it}\end{aligned} \tag{8}$$

The short-run multipliers are given by a_1, b_1, b_2, and b_3 and the inclusion of $\widehat{\epsilon}_{it-1}$

from the cointegrating equation is the error correction term.[13] The residuals u_{it} for each equation are a composite error of the following form:

$$u_{it} = \alpha_i + \alpha_i t + \omega_{it}$$

in which the residuals are a function of state-specific intercepts represented by α_i, a state-specific time trend $\alpha_i t$ and a white noise error term ω_{it}.

In estimating the error correction model, estimators such as SURE are infeasible due to the large T and large N structure of the panel. To accommodate the large T and large N structure of the data while exploiting dynamic properties, the mean-group (MG) estimator developed by Pesaran & Smith (1995) is used to estimate the short-run coefficients, state-specific intercepts and long-run adjustment coefficient. Therefore, the estimation strategy for estimating the error correction model is in the spirit of Pesaran *et al.* (1999)'s pooled mean-group (PMG) estimator, in which the short-run coefficients are allowed to be heterogeneous while constraining the long-run coefficients to be homogeneous across states.[14] The main benefit of the PMG estimator is that it relaxes the homogeneity assumption imposed on short-run coefficients. The large variances across transfer revenues and transfer expenditures found in Table 4 suggest the heterogeneity assumption on the short-run dynamics is more appropriate. PMG estimation of the short-run dynamics involves estimating equation (8) separately for each state and constructing the coefficients using an un-weighted average of the state-specific coefficients. According to Pesaran & Smith (1995) these unweighted averages of the group-specific regressions provide a consistent estimate of the average of the state-specific estimators. Furthermore, estimating the error correction model using the PMG estimator in first differences and including sufficient lags ensures the residuals are free from serial correlation and the explanatory variables are exogenous (Pesaran *et al.*, 1999).

Short-run Estimates

Results from estimating the error correction model of equation (8) are in Table 7. The results from Table 7 show strikingly different results compared to the long-run estimates. Here, \$1 of federal aid stimulates transfer expenditures by only \$0.09. Tests of Granger causality support that federal aid Granger-cause aid to local government; however, the accumulated short-run estimates (the sum of the contemporaneous and lagged coefficients) show that the effect of federal aid is insignificantly different from zero. In Panel B the test results show support for the incomplete pass-through of

[13] The optimal lag length of two for the variables in the error correction model was chosen by the Akaike information criterion (AIC) and verified by Bayesian information criterion (BIC). The results do not appear to be influenced by the choice of the lag length.

[14] Other competing estimators include dynamic fixed effects and the mean-group estimators. The fixed effects estimator assumes heterogeneous group-specific intercepts, but constrains the error variances and all other coefficients to be homogeneous. The mean-group estimator assumes both the short-run and long-run coefficients are heterogeneous along with the long-run adjustment coefficient, error variances and intercepts. The pooled mean-group estimator, developed by Pesaran *et al.* (1999), offers an intermediary between the two by constraining the long-run coefficients to be homogeneous while allowing for heterogeneous short-run slope coefficients, which usually increases efficiency.

Table 7: Mean-Group Estimates of the Short-Run Pass-Through

Variables	(1) Grants	(2) Income	(3) Residual Expenditures
Panel A: Contemporaneous Pass-through			
b_{it}	0.092*	0.000	0.043
	(0.049)	(0.007)	(0.027)
Panel B: Tests of the Conduit Effect			
$H_0 : b_{it} = b_{it-1} = 0$	8.382**	1.569	3.805
	[0.015]	[0.456]	[0.149]
$b_{it} + b_{it-1}$	-0.019	0.009	0.009
	(0.070)	(0.010)	(0.010)
Panel C: Error Correction and MAL			
ϵ_{it-1}	-0.101***		
	(0.021)		
Mean Adjustment Lag	9.00	10.00	9.50
Observations	2,688	2,688	2,688
Number of States	48	48	48

Notes: Standard errors in parentheses and probability values are in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

federal aid to aid to local governments given by the rejection of the equivalence theorem.

Panel C of Table 7 displays the estimate of the speed of adjustment to equilibrium. The speed of adjustment is negative, statistically significant, and less than one in absolute value, suggesting a dynamically stable long-run relationship. To put these estimates in perspective, panel C provides estimates for the mean adjustment lag. The mean adjustment lag is calculated as $\frac{(1-b_0)}{\lambda}$ and provides a measure of the lag transmission. In other words, the mean adjustment lag measures the average time it takes changes in transfer expenditures to completely adjust to changes in transfer revenues and income. For example, following an increase in income, it takes transfer expenditures ten years to fully adjust whereas it takes only nine years for transfers expenditures to fully adjust to changes in federal transfers. These results reconcile the difference between the short and long-run results, as it takes many years for federal aid to fully pass-through to local governments. With respect to the conduit hypothesis, federal funds take as much as nine years to fully flow through the state government down to local governments. Comparing the short-run estimates with the long-run estimates, it appears to take many years for federal aid to fully transmit to local governments, as evidenced by the mean adjustment lag. Consequently, the conduit effect appears to be a long-run phenomenon. Given these long time lags, the next section provides a more illustrative view of the underlying dynamics using impulse response functions.

Impulse Response Functions

Impulse response functions are generated to visually examine the dynamics of

transfer expenditures over time given a one-time shock to federal aid and income. Following Jorda's (2005) method, impulse response functions are created from one-step-ahead forecasts using linear local projections. Linear local projections provide consistent estimates using simple regression techniques, such as ordinary least squares. Moreover, this method allows impulse response functions to be calculated from a single equation (see, e.g., Brady, 2011), as opposed to a system of equations, and is robust to various types of misspecification commonly found in VARs and VECMs. Following Haug & Smith (2007) the local projections are applied to levels data by estimating the following equation using OLS with state-specific intercepts.[15]

$$E_{it+s} = a_i^s + \sum_{k=0}^{1} b_{i,1,t-k}^{s+1} G_{it-k} + \sum_{k=0}^{1} b_{i,2,t-k}^{s+1} I_{it-k} + \sum_{k=1}^{1} b_{i,3,t-k}^{s+1} EX_{it-k} + u_{it}^s$$

where s=1,2,...,h. The impulse response function is then calculated as:

$$\widehat{IRF}(i,t,s,d) = \widehat{b}_{i,t}^s, s = 1,2,...,h \tag{9}$$

where d represents a $1 shock in federal aid or income at time t and s denotes the forecasting period. The standard errors and corresponding confidence bands are calculated at each regression. For example, the response of intergovernmental aid to local governments to a shock of federal aid is given by $\widehat{b}_{1,t}^s$ for $s = 1,2,...,h$. The impulse response functions illustrate the dynamics leading to the long-run equilibrium.

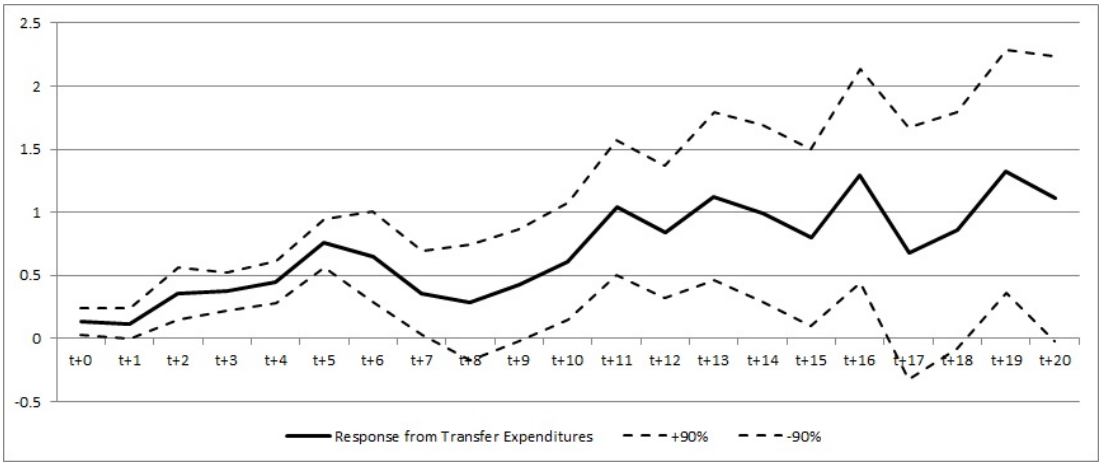


Figure 17: One-time Shock of Federal Aid

[15]Using a Monte Carlo approach, Lin & Tsay (1996) show that direct forecasts perform better in the presence of unknown unit roots and cointegration and when unit roots and cointegration are ignored completely. This is due to unit root tests recomending too few or too many cointegrating vectors resulting in misspecification of the error correction model (Haug & Smith, 2007).

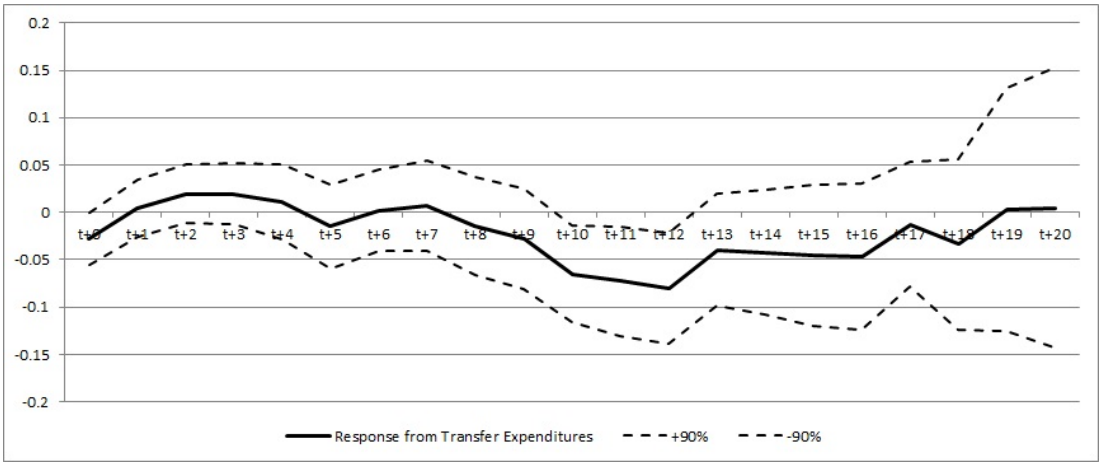


Figure 18: One-time Shock of Personal Income

The impulse response functions uncover significant differences in the dynamics over time in response to shocks of federal aid and income. Figure 17 shows the response of transfer expenditures to a one-time shock in federal aid. Interestingly, federal aid induces a small immediate increase in transfer expenditures, but produces a much greater effect over time. In fact, after period t+9 the effect of federal aid on transfer expenditures approaches one and these coefficients are all insignificantly different from one which confirms the strong form of the conduit hypothesis. These results illustrate the dynamics leading to long-run equilibrium. The mean adjustment lag of nine years coincide with Figure 17 in that is takes roughly nine years before converging to one. A $1 shock in community income shown in Figure 18 shows no discernible response by transfer expenditures. The impulse response functions not only confirm the previous estimates, but also show that transfer expenditures appear to converge to unity after nine years, which coincides with the strong form of the conduit hypothesis and confirm the long-run nature of the conduit behavior among states.

Overall, the aggregate results reveal that a cut in federal aid to states has a large effect on aid to local governments greater than a reduction in income. The statistical relationship between aggregate federal-to-state transfers and state-to-local warrants an analysis on the interactions among the different transfer categories. In order to better understand the presence of resource diversion and the relationships among the various programs funded by both transfer revenues and transfer expenditures, the following sections repeat the analysis using disaggregate transfers revenues and transfer expenditures.

3.3.3 Disaggregated Sample

In this section aggregate transfer expenditures and transfer revenues are disaggregated, with parsimony in mind, into the four largest transfer categories including, public welfare, education, highways, and health and hospitals (See Appendix A for definitions). I take a more agnostic approach as to the theoretical relationship among

these transfer categories and instead use an error correction model to reveal the relationships in the data. For comparison purposes direct expenditures are also disaggregated into the four categories. Given the differences relating to the funding of each transfer revenue and transfer expenditure program this section unveils a more clear picture of grant fungibility and resource diversion. For example, if interests between the federal government and state governments are mis-aligned it's possible states use public welfare aid to fund education aid to local governments. The cointegrating equation representing the disaggregated transfer categories is given by the following equation:

$$E_{it} = \alpha_i + \beta_1 ED^r_{it} + \beta_2 HW^r_{it} + \beta_3 HH^r_{it} + \beta_4 PW^r_{it} + \beta_5 I_{it} + \epsilon_{it} \tag{10}$$

where E_{it} is a vector of intergovernmental expenditures and direct expenditures disaggregated into, education, highway, health and hospital and public welfare. The right hand side variables include intergovernmental revenues for education (ED), highway (HW), health and hospital (HH) and public welfare (PW); personal income (I); and State fixed effects (α_i). The cointegrating vectors β_1 to β_4 provide a measure of long-run pass-through from federal aid to local governments, and β_5 measures the long-run propensity to finance intergovernmental expenditures using community income (when the dependent variable is transfer expenditures).

Estimates of the long-run pass-through of federal aid to local governments, using DOLS, are in Table 8.[16] Remarkably, education aid to local governments respond positively to all federal aid (except aid given for highways). Specifically, a $1 increase in federal aid assigned to health and hospitals and public welfare increase education aid to local governments by $0.57 and $0.15, respectively. Likewise, federal aid for education increases education aid to local governments by $1.73 for every $1 increase. On the other hand, a reduction in federal aid given for the purposes of public welfare and health and hospital aid would translate to a reduction in education aid to local governments. In column 2, a $1 increase in highway and health and hospital federal aid reduces public welfare aid to local governments by $0.57 and $0.47, respectively. However, public welfare aid to local governments increases by $0.23 following a $1 increase in federal public welfare aid. In column 3, health and hospital aid to local governments are stimulated by federal health and hospital aid by only $0.06 following a $1 increase. However, health and hospital aid to local governments declines by $0.15 following a $1 increase in federal highway aid. Curiously, an increase in federal highway aid reduces highway aid to local governments by $0.14, but federal education aid stimulates highway aid to local governments by $0.18.

Comparing these estimates with direct expenditures, located in columns 7 through 10, shows a number of disparities between transfer expenditures and direct expenditures. For example, states funnel $1.73 of federal education aid to education aid to local governments and spend only $0.90 on direct education expenditures. Fur-

[16] Given the similarities in estimators found in the previous section, only DOLS is used to estimate the cointegrating equation. The DOLS estimates were confirmed by the 2SLS estimates, but these are not reported.

thermore, following a $1 increase in education grants, states increase public welfare aid to local governments by $0.46 and decrease direct spending on public welfare by $0.30. Alternatively, states increase direct highway expenditures by $1.42 following a $1 increase in federal highway aid and decrease their highway expenditures to local governments by $0.14. Interestingly, a $1 increase in federal health and hospital aid results in an increase in education aid to local governments and direct education expenditures by $0.57, whereas the response from direct and transfer expenditure for health and hospital aid to local governments is only $0.29 and $0.06, respectively. On the other hand, the same increase in health and hospital federal aid decrease public welfare aid to local governments by $0.47, but increase spending on direct public welfare expenditures by $1.12. Finally, a $1 increase in federal public welfare aid increases education aid to local governments with no effect on direct education expenditures. Furthermore, a $1 increase in federal public welfare aid stimulates public welfare aid to local governments by $0.23 and direct spending on public welfare by $0.97. Overall, these results show that states use federal aid to fund a number of different spending programs that are in some instances far removed from their intended allocation. Federal education aid, to a large degree is funneled to local governments which is consistent Oates' Decentralization Theorem; however, state governments prefer to use federal highway and public welfare aid to fund, largely, direct expenditures in highway and public welfare. Conceivably, highways and public welfare programs possess significant economies of scale and spillover effects beyond what can be internalized by state government grants and thus warrants state governments to direct these programs to ensure an optimal level. Of course, these results only show the long-run relationship. In the next section, the error correction model is estimated to examine the short-run dynamics.

Panel Error Correction model

The error correction equation for the disaggregated expenditures and federal aid is given by:

$$\begin{aligned}\Delta E_{it} = &\sum_{k=1}^{n} a_{i,1,t-k}\Delta E_{it-k} + \sum_{k=0}^{n} b_{i,1,t-k}\Delta ED^{r}_{it-k} + \sum_{k=0}^{n} b_{i,2,t-k}\Delta PW^{r}_{it-k} \\ &+ \sum_{k=0}^{n} b_{i,3,t-k} + \Delta HH^{r}_{it-k} + \sum_{k=0}^{n} b_{i,4,t-k}\Delta HW^{r}_{it-k} + \sum_{k=0}^{n} b_{i,5,t-k}\Delta I_{it-k} + \lambda_i \widehat{\epsilon}_{it-1} + u_{it}\end{aligned} \tag{11}$$

where E_{it} is replaced by each of the four transfer expenditure categories along with disaggregated direct expenditures.[17] The short-run multipliers are given by b_1 through b_5 and the error correction term is $\widehat{\epsilon}_{it-1}$. The residuals u_{it} for each equation are a combination of a state-specific intercept, state-specific time trend and a white noise error term.

Short-run Estimates

[17]Direct expenditures are also disaggregated into direct expenditures on education, highway, health and hospital and public welfare.

Table 8: DOLS Estimates of the Long-Run Pass-Through

	Intergovernmental Expenditures				Direct Expenditures			
Variables	(1) Education	(2) Public Welfare	(3) Health Hospital	(4) Highway	(5) Education	(6) Public Welfare	(7) Health Hospital	(8) Highway
Education	1.727***	0.459***	0.157***	0.181***	0.895***	-0.296***	0.304***	-0.154***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Highway	-0.188*	-0.564***	-0.145***	-0.140***	0.226***	0.169**	-0.180***	1.416***
	[0.056]	[0.000]	[0.000]	[0.000]	[0.000]	[0.029]	[0.000]	[0.000]
Health & Hospital	0.565***	-0.465***	0.057*	0.142***	0.566***	1.119***	0.293***	-0.044
	[0.000]	[0.000]	[0.057]	[0.000]	[0.000]	[0.000]	[0.000]	[0.225]
Public Welfare	0.148***	0.233***	0.043***	-0.050***	-0.015***	0.965***	0.170***	-0.045***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]
Income	0.008***	0.014***	0.004***	0.000	-0.000***	0.012***	0.004***	-0.003***
	[0.001]	[0.000]	[0.000]	[0.161]	[0.000]	[0.000]	[0.000]	[0.000]
Tests of the Conduit Hypothesis								
$\beta_{education} = \beta_{income}$	14.88***	11.35***	6.23***	8.69***	11.34***	-3.55***	5.51***	-3.81***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$\beta_{highway} = \beta_{income}$	-1.66**	-9.86***	-5.92***	-6.51***	2.80***	1.77**	-3.29***	34.87***
	[0.049]	[0.000]	[0.000]	[0.000]	[0.003]	[0.038]	[0.001]	[0.000]
$\beta_{health\&hospital} = \beta_{income}$	3.31***	-5.76 ***	1.48*	4.70***	4.92***	8.77***	3.64***	-0.7
	[0.000]	[0.000]	[0.07]	[0.000]	[0.000]	[0.000]	[0.000]	[0.241]
$\beta_{publicwelfare} = \beta_{income}$	3.24***	10.27***	4.35***	-6.44***	-0.5	29.54***	8.17***	-2.82***
	[0.001]	[0.000]	[0.000]	[0.000]	[0.308]	[0.000]	[0.000]	[0.002]
$\beta_{education} = 1$	6.28***	-39.15***	-34.18***	-9.42***	-1.32*	34.76***	-12.72***	-14.9***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.093]	[0.000]	[0.000]	[0.000]
$\beta_{highway} = 1$	-10.03***	-53.28***	-45.43***	-26.64***	-9.55***	10.200***	-21.11***	-9.35***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$\beta_{health\&hospital} = 1$	-2.59***	-28.28***	-26.39***	-17.61***	-3.78***	-18.08***	-8.92***	0.95
	[0.005]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.172]
$\beta_{publicwelfare} = 1$	-19.79***	-135.11***	-104.37***	-35.93***	-34.48***	-70.57***	-40.86***	-1.07
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.142]
Observations	2,784	2,784	2,784	2,784	2,784	2,784	2,784	2,784
R-Squared	0.211	0.383	0.133	0.183	0.231	0.61	0.15	0.699
Number of States	48	48	48	48	48	48	48	48

Notes: t-stats are in parentheses. One lag and lead of the differenced regressors are included in each regression. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

Results from estimating the error correction model of equation (3.11) are in Table 15. Consistent with the "conduit" hypothesis and the results from the previous section, the results from Table 3.6 reveal evidence of incomplete pass-through of federal aid to local governments.[18] Remarkably, the largest transfer expenditure category, education, shows evidence of pass-through from the largest transfer revenue category, public welfare. For example, a $1 increase in federal public welfare aid increases education aid to local governments by $0.08. Furthermore, increases in federal health and hospital aid increase health and hospital aid to local governments by $0.11. Turning to direct expenditures, each federal aid category stimulates its corresponding direct expenditures category almost exclusively. Tests of the conduit behavior reveal evidence in favor of incomplete pass-through for federal public welfare aid to education aid to local governments and federal health and hospital aid to health and hospital aid to local governments. These results show limited evidence in favor of the conduit hypothesis and instead suggest that federal aid, to a large extent, stimulates direct expenditures in the short run. Also, each federal aid category stimulates, almost exclusively, its corresponding direct expenditure category.

The short-run results shown here give the marginal propensity to spend on each transfer and direct expenditure category. In particular, the marginal propensity to

[18] Appendix E reports estimates for the accumulative short-run effects. These are constructed as the sum of the coefficients on the contemporaneous and lagged variables.

Table 9: Mean-Group Estimates of the Short-Run Pass-Through

	Intergovernmental Expenditures				Direct Expenditures			
Variables	(1) Education	(2) Public Welfare	(3) Health Hospital	(4) Highway	(5) Education	(6) Public Welfare	(7) Health Hospital	(8) Highwayheight
Education	0.237	0.045	0.011	-0.033	0.340***	-0.460**	0.028	-0.044
	(0.211)	(0.035)	(0.024)	(0.034)	(0.131)	(0.205)	(0.071)	(0.093)
Highway	-0.136	0.006	-0.013	0.007	0	0.115	-0.026	0.763***
	(0.116)	(0.017)	(0.013)	(0.014)	(0.065)	(0.105)	(0.043)	(0.062)
Health & Hospital	0.33	0.022	0.113**	-0.004	0.400*	-0.134	0.255**	0.011
	(0.271)	(0.053)	(0.051)	(0.040)	(0.216)	(0.423)	(0.129)	(0.213)
Public Welfare	0.084*	0.005	-0.004	0.001	0.03	0.678***	0.038	0.037
	(0.050)	(0.010)	(0.008)	(0.008)	(0.036)	(0.069)	(0.036)	(0.029)
Income	-0.004	0.001	0.001	-0.001	-0.004	0.014**	0.001	0.006**
	(0.006)	(0.001)	(0.001)	(0.001)	(0.003)	(0.006)	(0.002)	(0.003)
Tests of the Conduit Hypothesis								
$b_{education} = b_{income}$	1.303	1.566	0.185	0.865	6.886***	5.324**	0.151	0.293
	[0.254]	[0.211]	[0.667]	[0.352]	[0.009]	[0.021]	[0.697]	[0.588]
$b_{highway} = b_{income}$	1.295	0.11	1.093	0.307	0.003	0.934	0.389	150.034***
	[0.255]	[0.741]	[0.296]	[0.580]	[0.958]	[0.334]	[0.533]	[0.000]
$b_{health\&hospital} = b_{income}$	1.512	0.158	4.952**	0.009	3.483*	0.122	3.873*	0.001
	[0.219]	[0.691]	[0.026]	[0.924]	[0.062]	[0.727]	[0.049]	[0.981]
$b_{publicwelfare} = b_{income}$	3.060*	0.218	0.344	0.049	0.882	92.534***	1.049	1.127
	[0.080]	[0.641]	[0.558]	[0.825]	[0.348]	[0.000]	[0.306]	[0.288]
$b_{education} = 1$	13.149***	737.576***	1731.477***	904.126***	25.281***	50.591***	186.235***	125.553***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$b_{highway} = 1$	0.072*	-0.003**	-0.006*	-0.013*	0.108*	0.762	0.074**	-0.036*
	[0.079]	[0.013]	[0.010]	[0.012]	[0.054]	[0.107]	[0.043]	[0.047]
$b_{health\&hospital} = 1$	6.116**	339.811***	308.124***	642.599***	7.705***	7.170***	33.151***	21.477
	[0.013]	[0.000]	[0.000]	[0.000]	[0.006]	[0.007]	[0.000]	[0.000]
$b_{publicwelfare} = 1$	335.573***	9962.722***	16085.963***	15617.752***	713.466***	21.822***	718.294***	1103.710***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	2,688	2,688	2,688	2,688	2,688	2,688	2,688	2,688
Number of States	48	48	48	48	48	48	48	48

Notes: Standard errors are in parentheses. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

spend on local government aid shows that federal aid devoted to public welfare are partially captured by the state and diverted to education in the form of local government aid. Also, federal health and hospital aid is partially spent on health and hospital aid to local governments. In confirmation of the conduit hypothesis these results reveal significant funneling of federal aid to local governments beyond what is expected from an income effect. Moreover, state's are partaking in cross-program substitutions by diverting resources from their intended allocation and re-directed to such expenditures as education aid to local governments. Taken literally, the results suggest that the median voter demands the level of education to be determined at the local level, whereas public welfare and highway should largely be determined by the state. Also, the median voter prefers, at least in part, that federal health and hospital and public welfare aid be used to finance education aid to local governments. This is perhaps due to the importance that the median voter places on education and thus prefers local governments to be responsible for education since they not only have more knowledge of the costs and benefits of providing education, but gives the median voter more control over the decision making process, therefore enhancing accountability as well.

Compared to the long-run estimates,the short-run estimates reveal strikingly different spending behavior. There exhibits limited evidence of grant fungibility as federal aid stimulates its corresponding direct expenditure category with limited effect on aid to local governments. Alternatively, long run estimates exhibit an appreciable amount of fungibility associated with federal aid suggesting that states have more

Table 10: The Speed of Adjustment and Mean Adjustment Lag

	Intergovernmental Expenditures				Direct Expenditures			
Variables	(1) Education	(2) Public Welfare	(3) Health Hospital	(4) Highway	(5) Education	(6) Public Welfare	(7) Health Hospital	(8) Highwayheight
Panel A: Speed of Adjustment (Error Correction)								
ϵ_{it-1}	-0.098*** (0.028)	-0.026** (0.013)	-0.086*** (0.025)	-0.067*** (0.019)	-0.106*** (0.039)	-0.111*** (0.041)	-0.039* (0.023)	-0.261*** (0.039)
Panel B: Mean Adjustment Lag								
Education	7.77	36.21	11.45	15.35	6.23	13.18	24.79	4.00
Highway	11.56	37.66	11.73	14.76	9.45	7.99	26.18	0.91
Health & Hospital	6.82	37.08	10.27	14.94	5.67	10.23	19.00	3.79
Public Welfare	9.32	37.70	11.63	14.85	9.16	2.90	24.55	3.69
Income	10.21	37.88	11.57	14.88	9.48	8.90	25.49	3.80
Average	9.14	37.30	11.33	14.96	8.00	8.64	24.00	3.24

Notes: Standard errors are in parentheses. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

flexibility in dictating the allocation of federal transfers in the long run, thus federal transfers appear to be more fungible over time. This time period specific spending behavior can be masked when using static analysis, but by examining the dynamics help differentiate between the long run and short run given the time it takes for funds to be distributed and shifted among the many expenditure channels. The next section uncovers the timing of adjustment for each aid category.

The Speed of Adjustment and Mean Adjustment Lag

In this section, estimates of the speed of adjustment and the mean adjustment lag are given. These two measures provide insight into the adjustment process of each transfer expenditure and direct expenditures.

Panel A of Table 10 display estimates of the speed of adjustment to disequilibrium. All the estimates are negative, statistically significant, and less than one in absolute value, suggesting a dynamically stable long-run relationship. Education appears to adjust the fastest among the transfer expenditure categories, whereas public welfare aid is the slowest to adjust. To put these estimates in perspective, Panel B provides estimates for the mean adjustment lag. Recall, that the mean adjustment lag is calculated as $\frac{(1-b_0)}{\lambda}$ and provides a measure of the lag transmission. For example, it takes education aid given to local governments anywhere from seven to twelve years to fully adjust to changes in federal aid. On the other hand, public welfare aid to local governments exhibits extremely slow adjustment. Health and hospital and highway aid to local governments take as much as eleven to fifteen years, respectively, to fully adjust. In contrast, direct expenditures exhibit relatively faster mean adjustment lags, except with respect to federal health and hospital aid. With respect to the conduit hypothesis, funds transferring from federal to local governments take on average eighteen years to fully flow to local governments; however, federal aid used to adjust direct spending take on average eleven to adjust. To illustrate the time paths of each transfer expenditure category following shocks in federal aid, the next section reports impulse response functions.

Impulse Response Functions

Impulse response functions are generated to visually examine the dynamics of each

transfer expenditure over time given a one-time shock to each federal aid category and income. Impulse response functions are estimated using the following ARDL equation:

$$\begin{aligned} E_{it+s} &= a_0^s + \sum_{k=1}^{1} a_{i,1,t-k}^{s+1} E_{it-k} + \sum_{k=0}^{1} b_{i,1,t-k}^{s+1} ED_{it-k}^r + \sum_{k=0}^{1} b_{i,2,t-k}^{s+1} PW_{it-k}^r \\ &+ \sum_{k=0}^{1} b_{i,3,t-k}^{s+1} HH_{it-k}^r + \sum_{k=0}^{1} b_{i,4,t-k}^{s+1} HW_{it-k}^r + \sum_{k=0}^{1} b_{i,5,t-k}^{s+1} I_{it-k} + u_{it}^s \end{aligned} \tag{12}$$

where s=1,2,...,h. The impulse response function is then calculated as:

$$\widehat{IRF}(i,t,s,d) = \widehat{b}_{i,j}^s, s = 1,2,...,h, j = 1,...,5 \tag{13}$$

where d represents a \$1 shock to federal aid j at time t. For example, the response of education aid to local governments to a shock of federal public welfare aid is given by $\widehat{b}_{2,t}^s$ for $s = 1,2,...,h$. The standard errors and corresponding confidence bands are calculated at each regression. Four of the impulse response functions are reserved for discussion here with the remainder located in Appendix F.

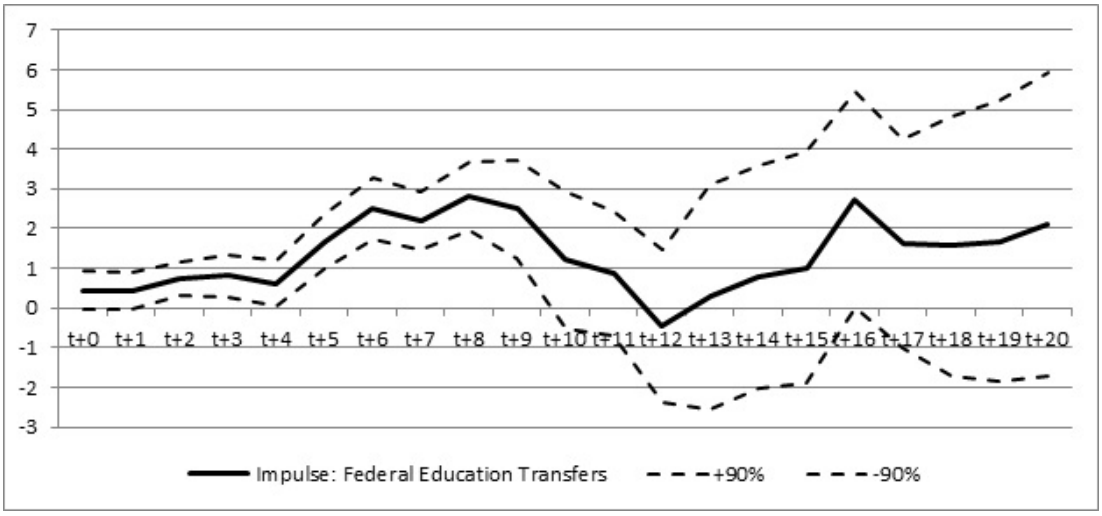


Figure 19: Response by education aid to local governments

Figures 19 and 20 give the response by education aid to local governments to shocks from federal education and public welfare aid, respectively. The first graph shows an initial positive response by education aid to local governments in excess of \$0.40 which reaches around \$0.80 by year three. After three years the response increases to a high of \$2.81 in year eight and then slowly dissipates to zero thereafter. The following graph shows an initial positive response by education aid to local gov-

ernments ranging from a low of $0.20 to a high of $0.28 and not decaying to zero until year six. Interestingly, the response dips below zero after fifteen years.

Figures 21 and 22 reveal the response of public welfare aid to local governments following shocks to federal health and hospital and highway aid, respectively. The first graph shows an initial negative, although statistically insignificant, response by public welfare aid to local governments, but in year eight the response falls to -$0.80 before returning back to zero in year ten. Finally the last graph shows an initial negative response by public welfare aid to local governments following a shock of federal highway aid which remains around -$0.30 until year seven. The first two figures illustrate the increases in resources devoted to education aid to local governments. The latter two figures, on the other hand, illustrate the diversion of resources from public welfare distributed to local governments.

Overall, the impulse response functions uncover significant dynamics over time in response to shocks to each of the four federal aid categories. Consistent with the prior findings many of these dynamics take many years before decaying to zero, which is an indication as to why the long-run pass-through results appear to be much larger than the immediate short-run pass-through, as it takes many years for states to adjust their aid expenditures in response to shocks of federal aid.

3.4 Discussion

The purpose of this study is to better understand how states spend federal aid, focusing on the degree to which state's serve as a conduit for federal funds funneled to local governments. It is assumed that that median voter demands a certain amount of federal aid to be funneled to local governments. This idea is in accordance with Oates's Decentralization theorem and the idea that the median voter has more control over more localized governments thereby making them more accountable. Moreover, it is assumed that local governments are more informed of the demands of the median voter, which explains why the median voter would prefer that federal grants be spent by local governments as opposed to the state, except in cases of spillovers. The dynamics also prove to be important as these decisions on how to allocate federal aid unfold over time resulting in an adjustment process. Indeed, the results show strikingly different spending behavior following a shock of federal aid in the short run compared to the long run. For instance, in the long run approximately $0.60 of every dollar of federal aid is funneled through the state down to local governments. However, in the short run, the stimulus from federal aid amounts to only $0.09. Therefore, the conduit behavior observed by state governments is a long-run phenomenon.

There are many possible explanations for this observed behavior. For example, perhaps administratively it is cheaper to allocate distributional responsibilities of federal aid down to local governments, or more in line with Oates' Decentralization Theorem in which lower level governments are in a better position to match the local benefits and costs of providing local public goods. Local governments are also perceived as being more informed and responsive to local demand. Furthermore,

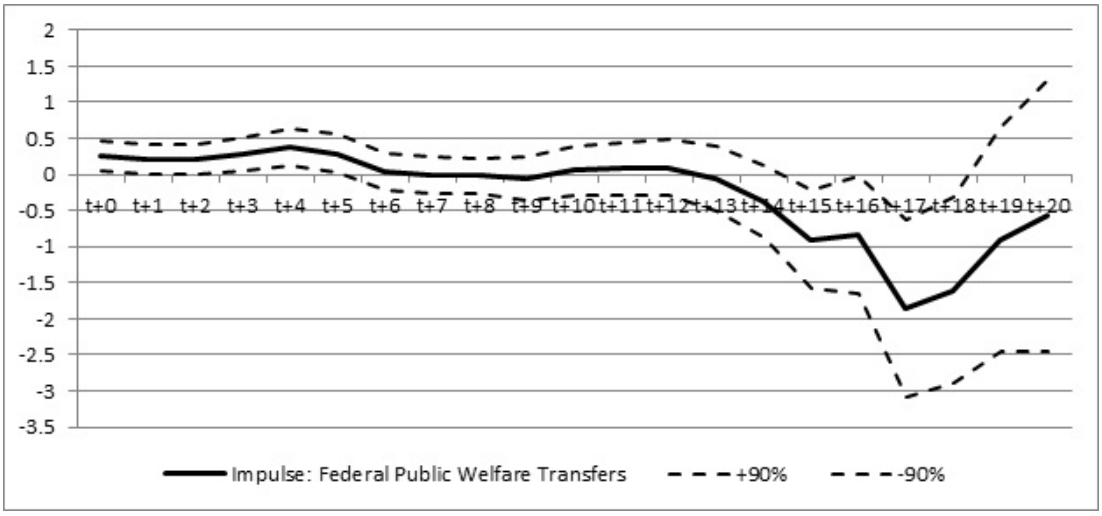


Figure 20: Response by education aid to local governments

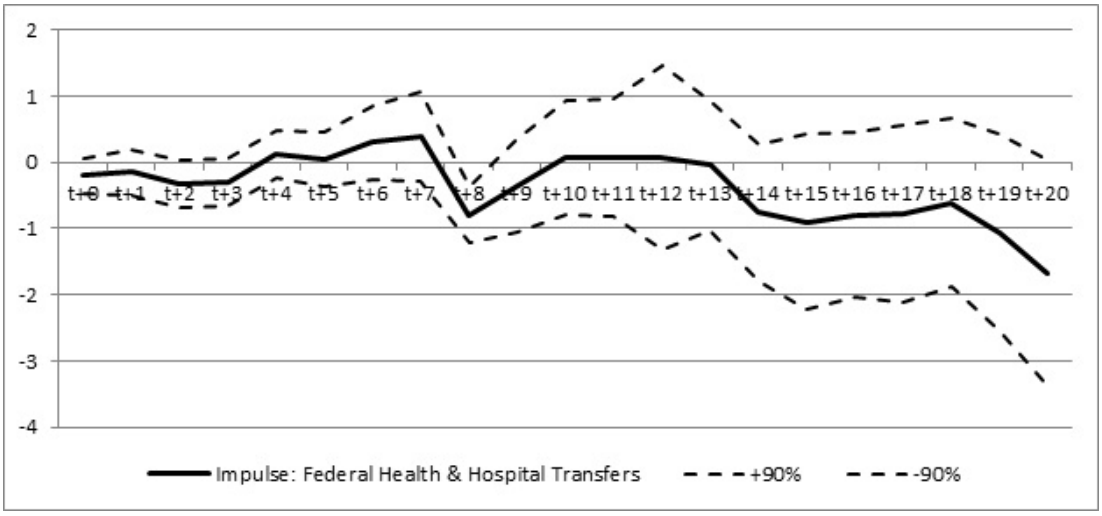


Figure 21: Response by public welfare aid to local governments

according to Oates (1985), referencing John Wallis, citizens have limited oversight of expenditures in more centralized governments and therefore wish to have spending done at local levels government for which they maintain more control and oversight on the decision making. Consistent with this view, the results in this study suggest that the median voter demands \$0.60 of every federal aid dollar to be spent by local governments leaving only \$0.40 for the state government to allocate.

Also, as some have suggested, the median voter can differ among the different layers of government in a federalist system. Here, however, the results differ in the short and long run suggesting different objective functions in each period. For instance, in the short run states capture the federal aid and finance their own expenditure projects, but in the long run states primarily finance local government aid with aid from the federal government. This seems plausible since short-run political pressures could persuade government bureaucrats to fund state level projects in order to maximize the chances of being re-elected, but in the long run where the cost of mobility of lower, government bureaucrats prefer to funnel the federal aid down to local governments. Consequently, a cut in federal aid would translate to a reduction in aid to local governments and since local governments have limited taxing authority this could lead to inefficient levels of local public goods.

Alternatively, it's possible local governments (e.g. schools districts, municipalities, county governments) are lobbying for state aid, which in turn provokes states to lobby for federal aid. In this case, local governments convey information of the demands from the median voter, distorted by political motives, which then translate to the observed spending behavior by states. In other words, the states' understanding of the median voter is viewed through the distorted lens of their local government constituents. Furthermore, over time the federal government's oversight in the allocation of federal aid is loosened allowing for a greater degree of fungibility in the dispersion of federal aid. This is consistent with the idea that state policy makers use federal aid to stimulate direct expenditures in the short run in order to reap the political benefits, but in the long run policy makers funnel federal aid down to local governments.

Disaggregating direct expenditures and transfer expenditures into expenditures on education, health and hospital, highway and public welfare, further uncovers interesting aspects of state level spending behavior. For instance, federal aid distributed for the purposes of education, health and hospital and public welfare were all used to stimulate education aid to local governments in the long run. On the other hand, federal highway aid reduces aid to local governments in all categories. Also, federal health and hospital aid reduces public welfare aid to local governments. Consequently, grant fungibility makes it impossible to know which programs are actually being funded and at which level of government. Therefore, federal grants intended to mitigate interstate spillovers should include provisions that encourage state spending on that particular program through the use of matching grants, for instance, so as to offset the incentive to engage in cross-program substitution; and including a time dimension as an additional provision forcing states to maintain certain spending levels for an extended period of time. However, block grants issued to states could be efficiently enhancing if states possess greater knowledge of the optimal level of public services.

Given the externality nature of such public goods as education, health and hospital, highways, and public welfare states could be using federal aid to encourage spending by local governments in an attempt to dictate their spending behavior and internalizing these spillovers. Coordination among local governments in a federation can be costly therefore states can use these federal grants to induce more efficiently provided public goods among local governments (Breton, 1965).

These results show that, consistent with Oates' Decentralization Theorem, states funnel federal aid to local governments primarily allocated toward education, even federal aid far removed from its intended allocation, such as, public welfare and health and hospital aid. On the other hand, states to a large degree appear to allocate highway and public welfare aid to their corresponding state level expenditures. Of course, the economies of scale attributes of highways and the externalities associated with public welfare validate the control by state governments in dictating the appropriate allocation of these funds. Especially when one considers highway infrastructure as a public input used to attract businesses into the state (see, e.g., Hauptmeier *et al.*, 2008). Furthermore, generous public welfare benefits attract welfare recipients (see, e.g., Saavedra, 2000). For instance, Blank (2001) showed that higher benefit levels lead to a higher number of welfare recipients, incentivizing a race-to-the-bottom in welfare benefits. Education, on the other hand, is intrinsically different in that residents' are very diverse in their demand for different types of education and funding sources (e.g. public versus private). Likewise, Alesina & Spolare (1998) argue for decentralized decision making in the case of heterogeneous populations due to the informational benefits. Furthermore, allowing local governments to dictate the allocation of funds provides added efficiency gains through the use of Tiebout sorting in determining the optimal level and type of education.

The conduit effect is closely related to the flypaper behavior associated with state spending. Understanding state behavior following an increase in federal grants serves as a check on the efficacy of the median voter model. The complication arises in federalist systems when there exists layers of government. For instance, state governments need to take into consideration the actions of their corresponding local governments to ensure the median voter's utility is maximized. Consequently, local governments have the incentive to lobby state governments for transfers to satisfy their residents. Moreover, this funneling of federal aid to local governments mean the perverse incentives of aid are transfered to local governments as well, such as, a "softening" of local budgets as in cases of bailouts (see Bird *et al.*, 1998). This particular study highlights the importance of intergovernmental linkages when understanding the flypaper anomaly. By disaggregating state level expenditures into direct expenditures and transfer expenditures unveils interesting characteristics of the flypaper effect, both over expenditure categories and over time. This chapter highlights the importance of both dynamics and spending categories in understanding the flypaper effect. States effectively funnel between \$0.60 and \$1.00 of federal aid down to local governments, consistent with the conduit hypothesis, however, direct expenditures exhibit a flypaper effect in the short run. These intricacies have the potential to inform on the current theoretical and empirical models of the flypaper effect in order to further the understanding of government behavior within a federalist system.

3.5 Conclusion

This study sheds light on the dynamics underlying the relationship between state-level intergovernmental transfer revenues and expenditures. In particular, the remarkably stable relationship observed between these two series motivates the possibility that states serve as a conduit for funds from the federal government to local governments. This idea is investigated using recent non-stationary panel time-series techniques. The results reveal statistically significant evidence in favor of states, to a large degree, using federal aid to finance local government expenditures beyond what is predicted by a pure income effect. Approximately, \$0.60 of every federal aid dollar is funneled to local governments in the long run. Moreover, the impulse response functions show evidence of states completely passing-through federal aid to local governments after ten years. This disparity highlights the importance of examining the relationships dynamically, as opposed to using static analysis. Moreover, these results reveal evidence that the conduit nature of state behavior of funneling federal aid to local governments is a long-run phenomenon. The results in this chapter inform the current literature on the flypaper effect in that states are using federal aid to finance local government expenditures in amounts greater than explained by a pure income effect. This channel if of interest as local governments possess a large degree of autonomy in taxation, spending and borrowing and therefore these funds can potentially finance programs far removed from their original intent by the federal and state government. Furthermore, there is a fairly extensive literature discussing the use of federal transfers to "soften" the budget of state and local governments inciting possible risky behavior on behalf of local governments. Therefore, funneling of federal aid to local governments also transfer the perverse side effects of federal aid.

Disaggregating both direct expenditures and transfer expenditures further uncovers interesting disparities in that states use federal aid allocated to education, health and hospital and public welfare to finance education aid to local governments. The most profound and robust result is the stimulative effect of public welfare aid on education aid to local governments in both the short run and long run. The interaction between these two series implies that if the federal government decided to cut its funding to public welfare this could lead to a reduction in education aid to local governments. These resource diversions serve as revealed preferences on the part of the state to allocate sufficient resources to local governments for the purposes of education. Alternatively, given the externality nature of public welfare and highways, states appear to allocate these funds directly to the program as opposed to going through the local governments to ensure an optimal amount is produced.

The results in this paper also serve to inform the median voter model. For instance, in a federalist system these intergovernmental linkages need to be exploited in order to better understand the objective functions of the different layers of government. From the state's perspective, maximizing the median voter's utility is done partially through financing local governments to ensure an optimal level of public goods necessary to satisfy the median voter, but these outcomes vary over time.

A topic for future research is then how local governments respond to these grants. Conceivably, local governments use their discretion to reallocate fiscal aid to fund

different programs not originally intended for by the state government. Also, in order to disentangle the price and income effects of public welfare grants the Medicaid component (major matching grant) of public welfare can be subtracted from public welfare and the equations can be re-estimated with the Medicaid component interacted with state-specific FMAPS (Federal Medical Assistance Percentages) along with the remaining public welfare transfers.

3.6 Appendix A

Below includes the Bureau of Census definitions of Intergovernmental transfers.

Intergovernmental Expenditure: Amounts paid to other governments as fiscal aid in the form of shared revenues and grants-in-aid, as reimbursements for performance of general government activities and for specific services for the paying government, or in lieu of taxes. Excludes amounts paid to other governments for purchase of commodities, property, or utility services, any tax imposed and paid as such, and employer contributions for social insurance–e.g., contributions to the Federal Government for Old Age, Survivors', Disability, and Health Insurance for government employees.

Intergovernmental Revenue: Amounts received from other governments as fiscal aid in the form of shared revenues and grants-in-aid, as reimbursements for performance of general government functions and specific services for the paying government (e.g., care of prisoners or contractual research), or in lieu of taxes. Excludes amounts received from other governments for sale of property, commodities, and utility services. All intergovernmental revenue is classified as General Revenue.

Education: Schools, colleges, and other educational institutions (e.g., for blind, deaf, and other handicapped individuals) and educational programs for adults, veterans, and other special classes. Higher Education includes activities of institutions operated by the state, except that agricultural extension services and experiment stations are classified under Natural Resources, and hospitals serving the public are classified under Hospitals. Revenue and expenditure for dormitories, cafeterias, athletic events, bookstores, and other Auxiliary Enterprises financed mainly through charges for services are reported on a gross basis. Direct Elementary and Secondary Education comprises direct state payments (rather than intergovernmental. payments to local governments) for operation of local public schools, construction of school buildings, purchase and operation of school buses, and other local school services. Direct state expenditure for Other Education includes state educational administration and services, tuition grants, fellowships, aid to private schools, and special programs.

Health: Outpatient health services, other than hospital care, including: public health administration; research and education; categorical health programs; treatment and immunization clinics; nursing; environmental health activities such as air and water pollution control; ambulance service if provided separately from fire protection services; and other general public health activities such as mosquito abatement. School health services provided by health agencies (rather than school agencies) are included here. Sewage treatment operations are classified under Sewerage.

Hospitals: Financing, construction, acquisition, maintenance or operation of hospital facilities, provision of hospital care, and support of public or private hospitals. Own Hospitals are facilities administered directly by the government concerned; Other Hospitals refers to support for hospital services in private hospitals or hospitals owned by other governments. However, see Public Welfare concerning vendor payments under welfare programs. Nursing homes are included under Public Welfare unless they are directly associated with a government hospital. Expenditures of state hospitals from Federal Medicaid funds are reported in this category.

Highways: Construction, maintenance, and operation of highways, streets, and related structures, including toll highways, bridges, tunnels, ferries, street lighting, and snow and ice removal. However, highway policing and traffic control are classed under Police Protection.

Public Welfare: Support of and assistance to needy persons contingent upon their need. Excludes pensions to former employees and other benefits not contingent on need. Expenditures under this heading include: Cash Assistance paid directly to needy persons under the categorical programs (Aid to Families with Dependent Children) and under any other welfare programs; Vendor Payments made directly to private purveyors for medical care, burials, and other commodities and services provided under welfare programs; and provision and operation by the government of welfare institutions including nursing homes not directly associated with a government hospital. Other Public Welfare includes payments to other governments for welfare purposes, amounts for administration, support of private welfare agencies, and other public welfare services.

Health and hospital services provided directly by the government through its own hospitals and health agencies, and any payments to other governments for such purposes are classed under those functional headings rather than here. Expenditures from Federal Medicaid funds, including distributions to local governments and payments to private medical vendors, are reported under Public Welfare except those spent by state hospitals (see Hospitals).

3.7 Appendix B

3.7.1 Unit Root Test

To test for stationarity among the variables the Fisher-type augmented Dickey-Fuller test by Choi (2001) is used along with the Breitung (2000) test and Im *et al.* (2003) test. These tests are conducted using the following autoregressive equation:

$$y_{it} = a_{it} + \rho_i y_{i,t-1} + e_{it} \tag{14}$$

where y_{it} is the variable of interest, and ρ_i is the autoregressive parameter to be estimated. These tests assume the variables are nonstationarity under the null hypothesis and stationary under the alternative. The Dickey-Fuller test conducts unit root tests on each individual state and then combines the p-values from each test to produce and overall test. The Breitung (2000) test uses a standard t statistic and assumes that all panels have a common autoregressive parameter. However, Breitung & Das (2005) state that this test has power in the heterogeneous case as well. In order to relax the homogeneity assumption of the autoregressive parameter, Im *et al.* (2003) is used. The Im *et al.* (2003) test assumes each panel has its own ρ_i. The alternative hypothesis is then a fraction of panels are stationary. In order to mitigate the impact of cross-sectional dependence each series is demeaned by subtracting the cross-sectional average from the series, as suggested by Levin *et al.* (2002). The results of the three unit root tests, preformed are found in Table 12 and 11. The results show overwhelming evidence in favor of each variable possessing properties of integration of order one in levels and stationary in first differences.[19]

[19] As robustness checks both the Harris & Tzavalis (1999) and Choi (2001)'s Phillips-Perron test were also conducted, which confirm the results found by the three reported unit root tests. The results are available upon request.

Table 11: Disaggregate Unit Root Results

Disaggregated Intergovernmental Revenues			
	Dickey-Fuller	Brietung	IPS
Education	7.01	8.96	11.91
	[1.000]	[1.000]	[1.000]
ΔEducation	-35.93	-29.88	-37.51
	[0.000]	[0.000]	[0.000]
Highway	0.01	2.9	2.35
	[0.502]	[0.998]	[0.991]
ΔHighway	-38.05	-32.16	-40.36
	[0.000]	[0.00]	[0.000]
Health & Hospital	6.34	8.73	13.18
	[1.000]	[1.000]	[1.000]
ΔHealth & Hospital	-28.47	-24.24	-27.21
	[0.000]	[0.000]	[0.000]
Public Welfare	6.01	8.96	14.56
	[1.000]	[1.000]	[1.000]
ΔPublic Welfare	-28.26	-24.76	-28.09
	[0.000]	[0.000]	[0.000]
Disaggregated Intergovernmental Expenditures			
	Dickey-Fuller	Brietung	IPS
Education	8.80	8.07	15.12
	[1.000]	[1.000]	[1.000]
ΔEducation	-23.96	-23.63	-23.36
	[0.000]	[0.000]	[0.000]
Highway	6.80	10.01	13.51
	[1.000]	[1.000]	[1.000]
ΔHighway	-30.67	-22.05	-30.85
	[0.000]	[0.000]	[0.000]
Health & Hospital	6.92	8.77	12.52
	[1.000]	[1.000]	[1.000]
ΔHealth & Hospital	-26.72	-24.48	-24.63
	[0.000]	[0.000]	[0.000]
Public Welfare	5.43	21.08	29.17
	[1.000]	[1.000]	[1.000]
ΔPublic Welfare	-20.50	-16.79	-20.26
	[0.000]	[0.000]	[0.000]
Disaggregated Own State Expenditures			
	Dickey-Fuller	Brietung	IPS
Education	8.56	13.11	18.99
	[1.000]	[1.000]	[1.000]
ΔEducation	-26.44	-22.16	-26.15
	[0.000]	[0.000]	[0.000]
Highway	0.54	4.12	3.41
	[0.706	[1.000]	[1.000]
ΔHighway	-35.02	-29.58	-36.06
	[0.000]	[0.000]	[0.000]
Health & Hospital	6.80	10.22	15.75
	[1.000]	[1.000]	[1.000]
ΔHealth & Hospital	-25.39	-23.39	-26.58
	[0.000]	[0.000]	[0.000]
Public Welfare	3.73	9.53	14.39
	[0.999	[1.000]	[1.000]
ΔPublic Welfare	-25.70	-24.60	-25.29
	[0.000]	[0.000]	[0.000]

Notes: Dickey-Fuller is the Augmented Dickey full test; Breitung is the Breitung test; and ips is the Im-Pesaran-shin test. The variable is assumed stationary under the null hypothesis for all tests. Probability values are enclosed in brackets. With respect to the Dickey-Fuller test, only the inverse normal statistic is reported.

Table 12: Aggregate Unit Root Results

	Dickey-Fuller	Brietung	IPS
Transfer Revenues	8.26	26.94	45.60
	[1.000]	[1.000]	[1.000]
ΔTransfer Revenues	-8.42	-9.71	-8.05
	[0.000]	[0.000]	[0.000]
Transfer Expenditures	8.01	28.21	48.54
	[1.000]	[1.000]	[1.000]
ΔTransfer Expenditures	-4.42	-6.66	-4.09
	[0.000]	[0.000]	[0.000]
Income	8.88	13.81	21.44
	[1.000]	[1.000]	[1.000]
ΔIncome	-15.89	-15.51	-15.30
	[0.000]	[0.000]	[0.000]

Notes: Dickey-Fuller is the Augmented Dickey full test; Breitung is the Breitung test; and ips is the Im-Pesaran-shin test. The variable is assumed stationary under the null hypothesis for all tests. Probability values are enclosed in brackets. With respect to the Dickey-Fuller test, only the inverse normal statistic is reported.

3.8 Appendix C

3.8.1 Cointegration Test

To test for cointegration the Pedroni (1999, 2004) heterogeneous panel cointegration test is employed to determine whether equation (7) is indeed a cointegrating relationship. The Pedroni test is a residual based test performed on the the predicted residuals from equation (7). The following unit root test is used to test for the absence of cointegration ($\rho = 1$) against the alternative that equation (7) is cointegrating ($\rho < 1$).

$$\hat{\epsilon}_{it}^{j} = \rho \hat{\epsilon}_{it-1}^{j} + \omega_{it} \tag{15}$$

The Pedroni test reports seven statistics. The first four panel statistics (v, ρ, pp, adf) are within dimension based statistics. These statistics assume a common value for ρ by pooling all the $\rho's$ across the different members. The next three group statistics (ρ, pp, adf) are between dimension based statistics, which allow for heterogeneity across the individual cross-sections by averaging individual ρ coefficients for each member. The results for Pedroni's cointegration test are in Table 18.

The highly statistically significant test statistics, in Table 18, show strong evidence in favor of cointegration for each equation. These results indicate there is a clear long-run relationship among the variables of interest that can be represented by equation (7). Evidence of cointegration validates that the error correction model of equation (6) is correctly specified with the inclusion of the error correction term.

Table 13: Pedroni's Heterogeneous Panel Cointegration tests

Panel A: Aggregated Data Variables	Transfer Expenditures	Own Expenditures	Own Revenues	
Panel v-statistic	10.21	20.36	12.87	
Panel ρ-statistic	-6.37	-28.32	-8.45	
Panel PP-statistic	-5.60	-23.03	-6.84	
Panel ADF-statistic	-6.05	-16.72	-6.16	
Group ρ-statistic	-7.94	-30.76	-8.57	
Group PP-statistic	-7.33	-29.00	-8.01	
Group ADF-statistic	-11.13	-21.07	-9.24	
Panel B: Intergovernmental Expenditures				
Variables	Education	Public Welfare	Health Hospital	Highway
Panel v-statistic	5.98	4.49	3.44	1.23
Panel ρ-statistic	-10.26	-5.86	-5.54	-5.40
Panel PP-statistic	-13.84	-9.28	-9.35	-9.47
Panel ADF-statistic	-5.43	-2.16	-4.52	-4.64
Group ρ-statistic	-10.38	-6.15	-5.89	-7.48
Group PP-statistic	-16.52	-11.23	-11.90	-13.49
Group ADF-statistic	-7.54	-2.28	-7.99	-8.14
Panel C: Own Expenditures				
Variables	Education	Public Welfare	Health Hospital	Highway
Panel v-statistic	7.47	7.74	4.11	5.32
Panel ρ-statistic	-11.41	-9.93	-6.68	-10.22
Panel PP-statistic	-16.25	-15.80	-11.46	-15.50
Panel ADF-statistic	-8.79	-11.71	-5.69	-8.52
Group ρ-statistic	-10.71	-10.52	-8.70	-9.99
Group PP-statistic	-17.85	-19.87	-16.32	-17.83
Group ADF-statistic	-9.62	-14.37	-9.97	-8.15

Notes: All test statistics are distributed standard normal. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

3.9 Appendix D

Table 14: Estimates of Long-Run Pass-Through for Own-Revenues

Panel A: Estimates for Cointegrating Vectors								
Variables	(1) Fixed Effects	(2) Dynamic OLS	(3) 2SLS	(4) PMG	(5) Fixed Effects	(6) Dynamic OLS	(7) 2SLS	(8) PMG
Grants	0.893***	1.035	1.131***	1.033***	0.695***	1.022	1.026***	0.870***
	(0.036)	(0.075)	(0.107)	(0.044)	(0.050)	(0.082)	(0.123)	(0.050)
Income	0.086***	0.084	0.089***	0.075***	0.090***	0.084	0.089***	0.069***
	(0.003)	(2.780)	(0.005)	(0.004)	(0.006)	(2.192)	(0.008)	(0.005)
Unemployment Rate					-0.000*	-0.000	-0.000**	0.000
					(0.000)	(0.037)	(0.000)	(0.000)
Dependency Ratio					-766.714	-390.111	-185.695	-917.341***
					(495.947)	(160,229.285)	(578.625)	(301.379)
Population Density					38.408	55.770	517.361	1,174.707***
					(534.753)	(228,886.155)	(599.106)	(420.234)
Hansen J Statistic			6.278				5.857	
			[0.099]				[0.119]	
Observations	2,784	2,784	2,544	2,640	1,584	1,584	1,584	1,440
Number of States	48	48	48	48	48	48	48	48
Panel B: Tests of the Conduit Hypothesis								
H-0: $\beta_1 = 1520.6 * **$	4.00***	97.98***	474.0***	142.6***	0.268	60.03***	247.6***	
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.606]	[0.000]	[0.000]
H-0: $\beta_1 = \beta_2$	9.089	15.74	1.509	0.550	36.96	11.14	0.044	6.793
	[0.003]	[0.000]	[0.219]	[0.458]	[0.000]	[0.999]	[0.000]	[0.009]

Notes: t-stats are in parentheses. One lag and lead of the differenced regressors are included in each regression. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

3.10 Appendix E

Table 15: Accumulated Mean-Group Estimates of the Short-Run Pass-Through

	Intergovernmental Expenditures				Own Expenditures			
Variables	(1) Education	(2) Public Welfare	(3) Health Hospital	(4) Highway	(5) Education	(6) Public Welfare	(7) Health Hospital	(8) Highway
Education	0.183	0.034	0.047	-0.052	0.312	-0.576	-0.045	0.029
	(0.275)	(0.041)	(0.035)	(0.043)	(0.179)	(0.291)	(0.100)	(0.143)
Highways	-0.238	0.002	-0.007	0.026	-0.001	0.098	0.024	0.654
	(0.162)	(0.026)	(0.020)	(0.020)	(0.086)	(0.157)	(0.069)	(0.110)
Health & Hospital	0.273	0.077	0.104	0.015	0.483	-0.073	0.509	-0.021
	(0.404)	(0.087)	(0.072)	(0.055)	(0.300)	(0.599)	(0.206)	(0.336)
Public Welfare	0.072	-0.003	-0.006	-0.013	0.108	0.762	0.074	-0.036
	(0.079)	(0.013)	(0.010)	(0.012)	(0.054)	(0.107)	(0.043)	(0.047)
Income	0.012	0	0.001	0	-0.005	0.009	0.004	0.008
	(0.008)	(0.002)	(0.001)	(0.001)	(0.005)	(0.008)	(0.004)	(0.005)
Observations	2,688	2,688	2,688	2,688	2,688	2,688	2,688	2,688
Number of States	48	48	48	48	48	48	48	48

Notes: Standard errors are in parentheses.

3.11 Appendix F

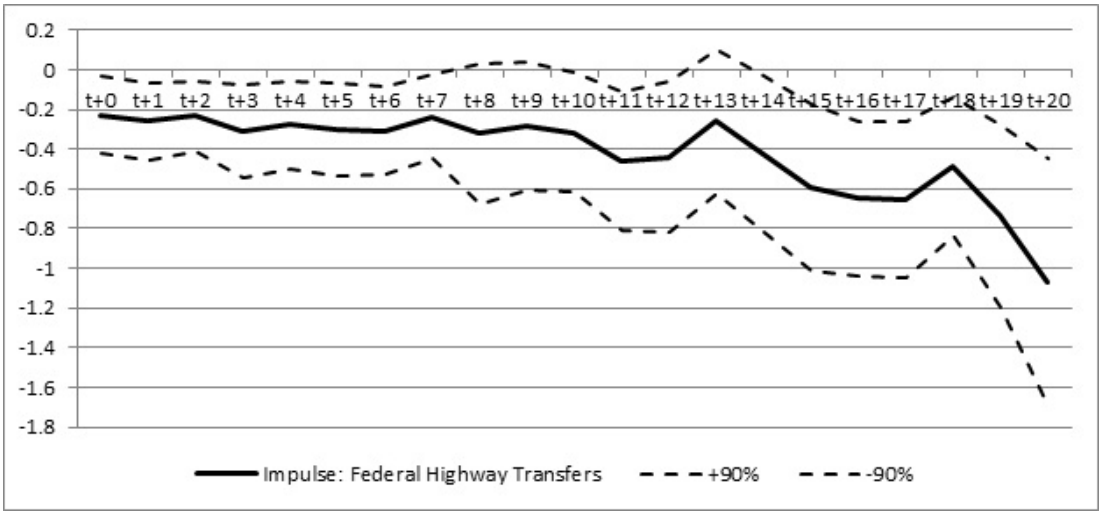


Figure 22: Response by highway aid to local governments

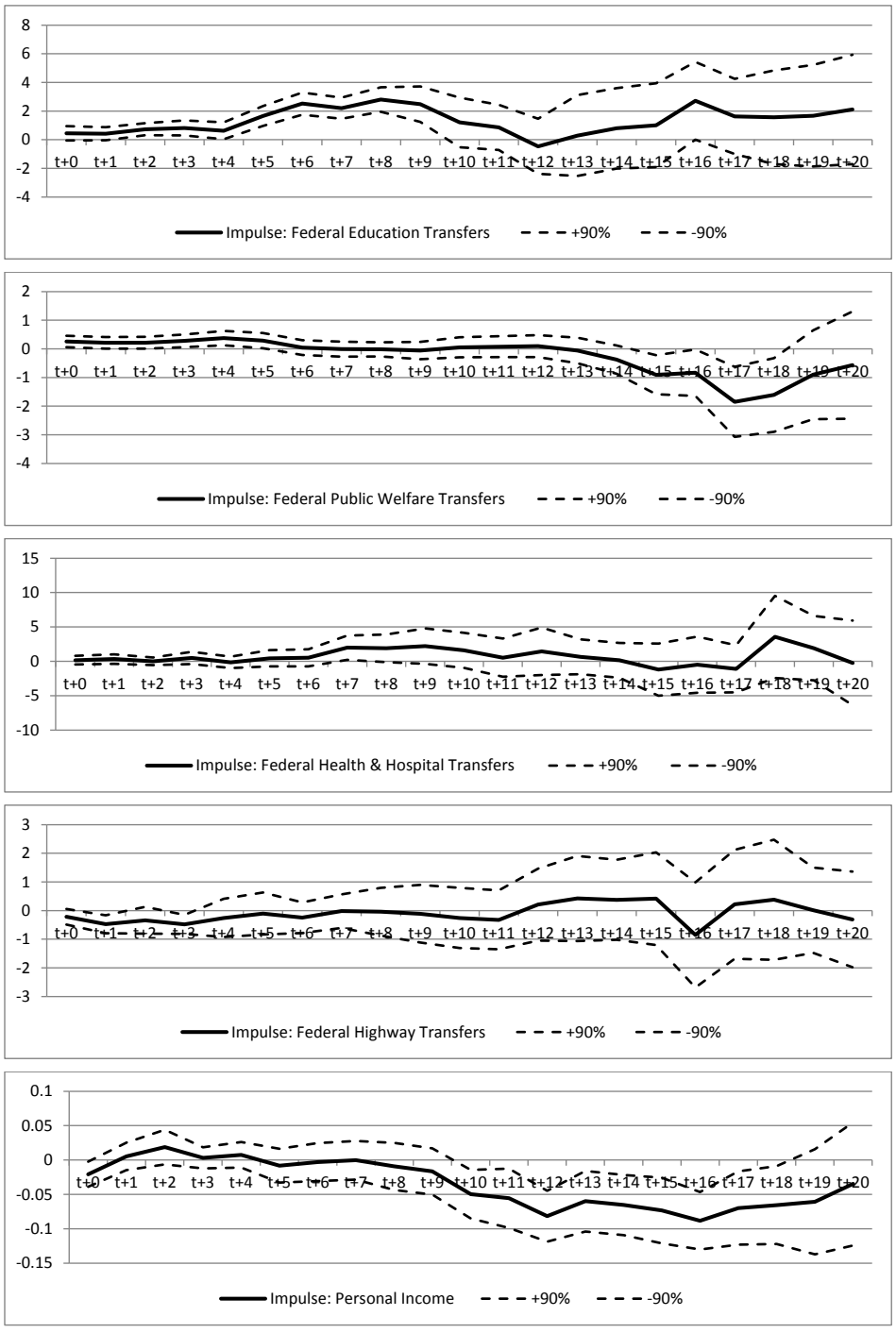


Figure 23: Response of Education Transfer Expenditures

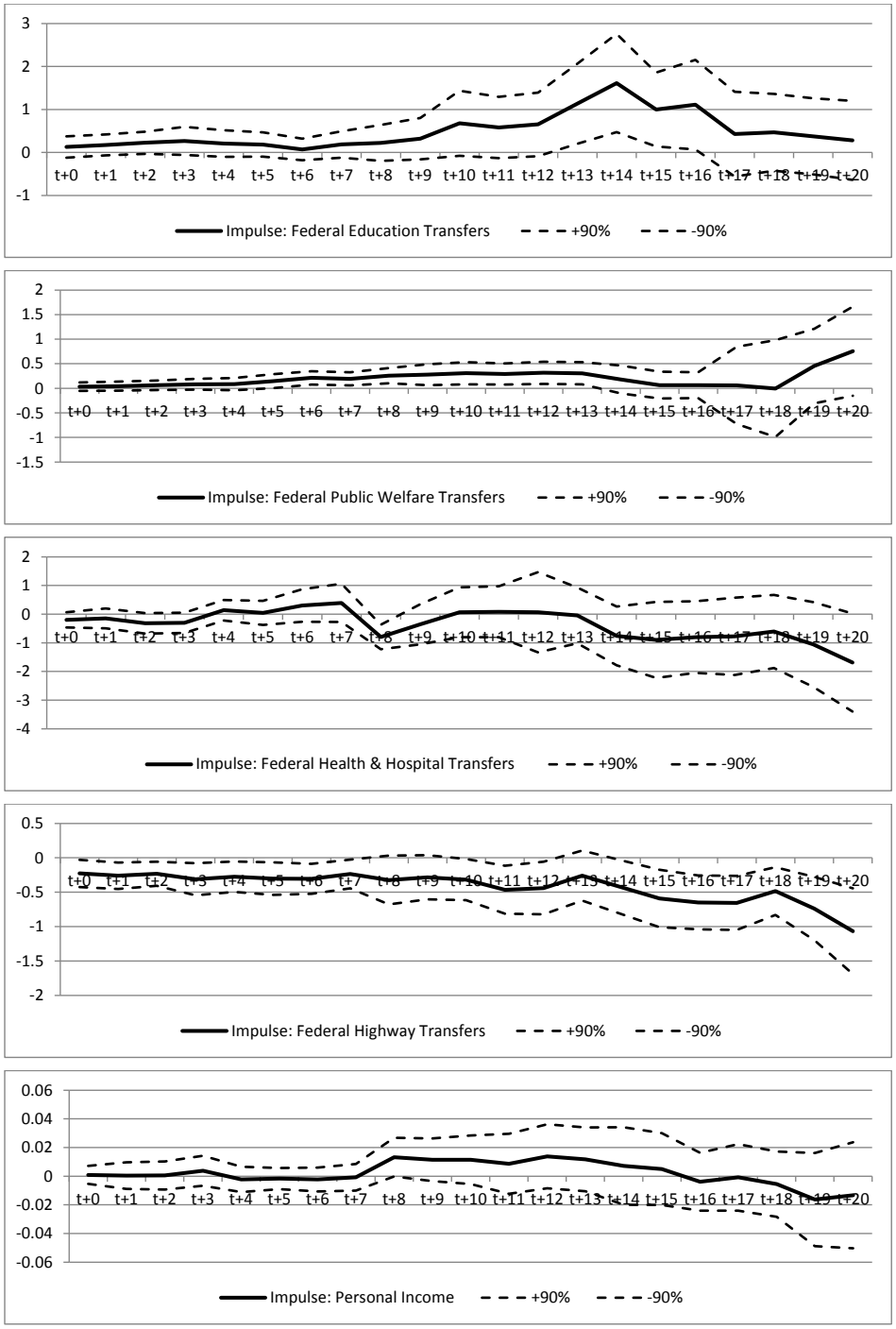


Figure 24: Response of Public Welfare Transfer Expenditures

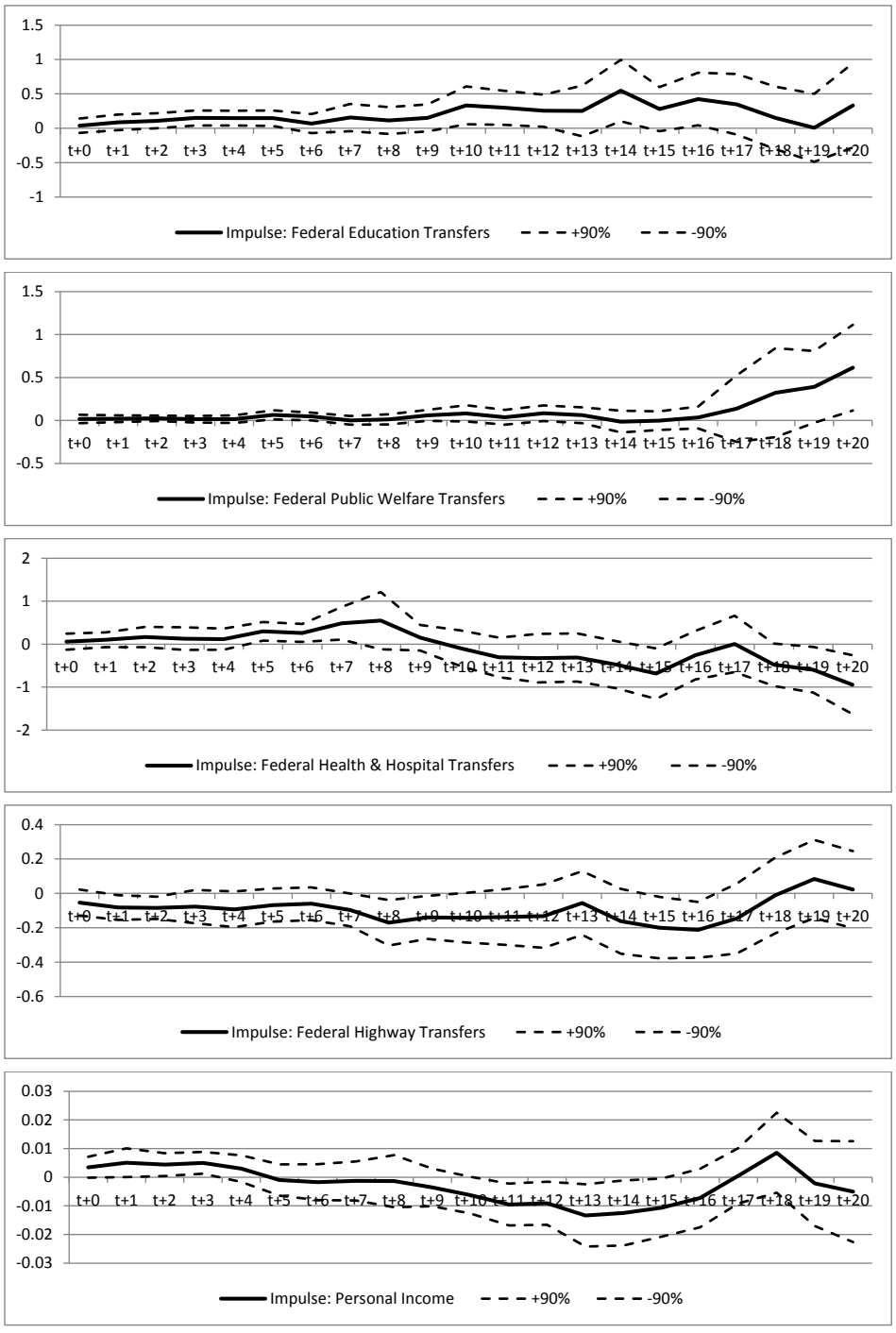


Figure 25: Response of Health & Hospital Transfers Expenditures

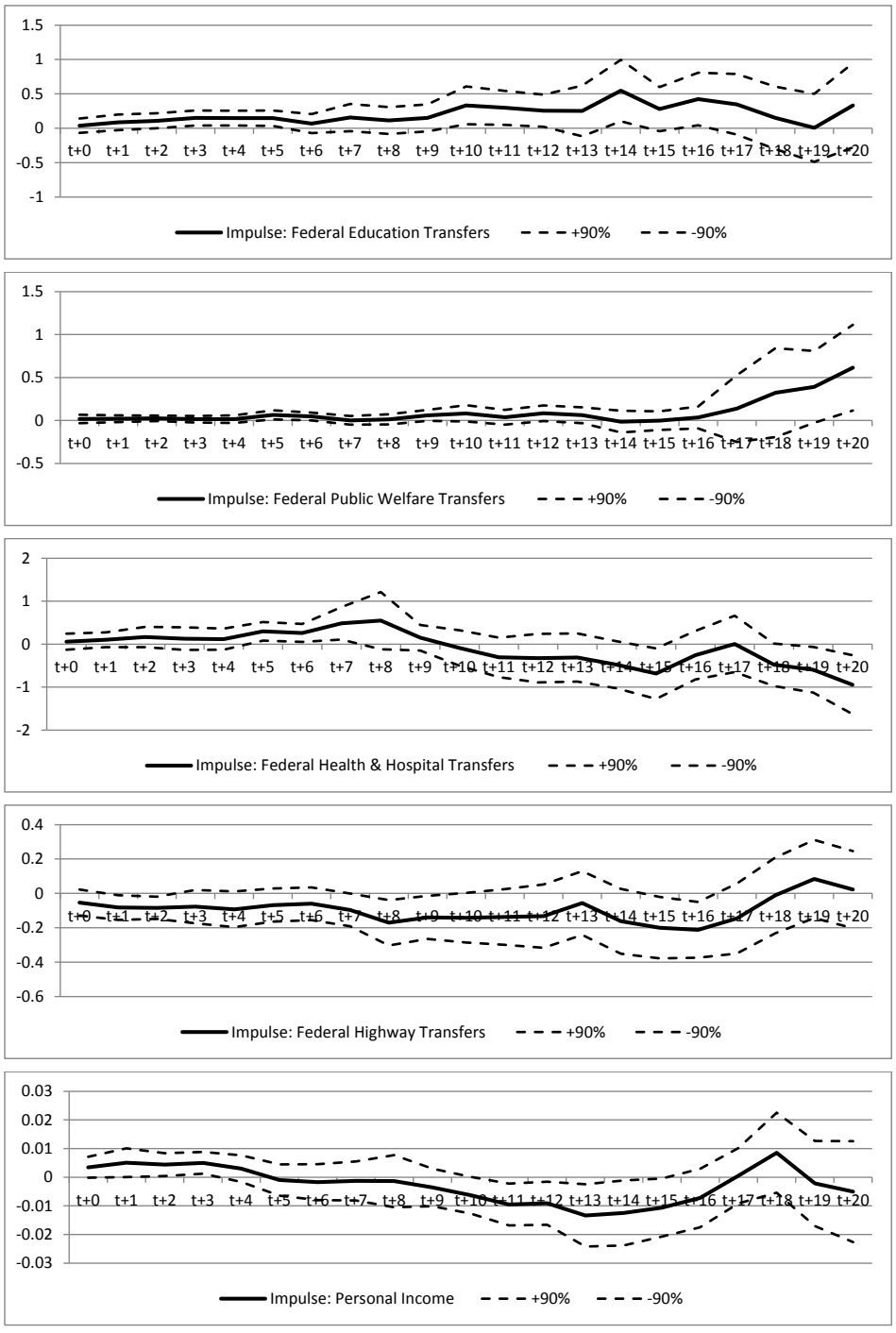


Figure 26: Response of Highway Transfers Expenditures

4 The Dynamics of the Revenue-Expenditure Nexus in State Government Finances

4.1 Introduction

Surmounting budget deficits among US states have become a major concern for policy makers and the public in general. A recent report from the Center on Budget and Policy Priorities claim that forty-four states project budget shortfalls for fiscal year 2012 totaling $125 billion. The correct policy response to budget deficits rests on the underlying relationship between revenues and expenditures. For instance, are deficits caused by overspending or insufficient revenues? In relation to the generation of budget deficits a strand a literature emerged known as the tax-spend debate, otherwise known as the revenue-expenditure nexus, which has focused on the intertemporal relationship between revenues and expenditures. Specifically, this literature focuses on the direction of causation between revenues and expenditures. Understanding this intertemporal relationships provide policy makers information on the correct policy response necessary to return budgets to equilibrium. For example, if government spending is determined by expenditure demand then the proper policy response to budget deficits would be to cut spending. Alternatively, if government spending is instead determined by resource supply then a cut in revenues would be necessary to reign in spending and return to a balanced budget.

In order to understand the intertemporal relationship between revenues and expenditures it is important to understand the institutions in which governments participate. Governments at all levels are subject to a variety of different constraints and incentives that elicit very different behavior among government officials that subsequently impact the tax-spend relationship. Particularly, US states face constitutional and legislative constraints that help to limit budgetary imbalances. In fact, all states, with the exception of Vermont, have, on an annual basis, a formal balanced budget requirement; however, these requirements vary considerably (Hines, 2010).

Also, within a hierarchical governmental system intergovernmental transfers provide another mechanism utilized by states to finance budget deficits and therefore need to be included in any examination of budgetary dynamics. In particular, over the past few decades US states have witnessed a dramatic increase in federal aid as percent of revenues. Recently, a report by the Center on Budget and Policy Priorities explains that part of the American Recovery and Reinvestment Act (ARRA) enacted in February 2009 provides $135 to $140 billion to assist states in maintaining current activities. The guidelines under which grants are distributed also influence incentives that would effect the tax-spend relationship. For example, block grants, as opposed to matching grants, have become more prevalent in the context of the United States since the initiation of the United States Welfare Reform of 1996 which converted the welfare program Aid to Families with Dependent Children (AFDC) from a matching grant to a block grant, thereby giving considerable more autonomy to states in the design of more appropriate welfare programs.

Using data on the contiguous forty-eight US states over five decades along with recent advances in non-stationary panel time series techniques, the task at hand is to understand the underlying dynamics of the revenue-expenditure nexus in answering

the four hypotheses relating to the direction of causality between revenues and expenditures. In addition, as federal grants have become an important revenue source among states, a closer examination of grants is given to ascertain the interrelationships among revenues, expenditures and grants. For example, are grants distributed to the community in the form of tax cuts or instead used to finance expenditures? Furthermore, this chapter uses a stratified sample based on the debt-to-population ratio to elucidate differences in the intertemporal tax-spend relationship between states with relatively high debt and those with low debt levels. In short, the results favor the absence of a short-run causal relationship between revenues and expenditures, but in the long run expenditures along with grants and other revenues, but not taxes, bear the adjustment burden. When the sample is stratified by the debt-to-population ratio the causal dynamics suggest high debt states rely on more precarious budget setting methods compared to low debt states, thus providing an fiscal environment favorable for debt accumulation.

Results from this analysis offer a number of important policy implications. An understanding of the relationship among the variables in the budget constraint allows policy makers greater ability to control state budgets. For instance, if causality is from taxes to spending (tax-spend) then a tax cut will reduce spending, but if causality is from spending to taxes (spend-tax) then a tax cut (or tax limit) will lead to deficits or poorly planned spending cuts. Therefore the results in this chapter inform policy makers as to the correct policies conducive to maintaining balanced budgets. Moreover, an understanding of the interactions between federal grants and other fiscal variables will assist policy makers in developing more appropriate methods of grant design and distribution so as to produce more efficient outcomes. Finally, understanding budgetary dynamics unveil important dynamic relationships that could be helpful in explaining and preventing the current evolution of unsustainable debt levels associated with many US states.

The remainder of this chapter is structured as follows: Section 4.2 discusses the tax-spend hypotheses along with a survey of the prevailing literature. Section 4.3 describes the empirical model. Section 4.4 provides the data and results. Sections 4.5 discusses the results based on the same split with respect to debt and concluding remarks are given in Section 4.6.

4.2 The Tax-Spend Debate

In the wake of mounting budget deficits both at the national and state levels it is imperative to examine the adjustment of either revenues, expenditures or both to budgetary shocks. Sustainability rests on the ability of revenues and expenditures to adjust to budgetary imbalances thus an examination of these adjustment dynamics is warranted. A related topic concerns itself with the temporal causality between revenues and expenditures. In answering this question and addressing the direction of causality there are currently four hypotheses: tax-spend , spend-tax, fiscal synchronization, and institutional separation.

The tax-spend hypothesis, argued by Friedman (1978), declares that increases in tax revenues lead to increases in expenditures. Friedman claimed that an increasing

amount of revenues provides governments with more resources for which they could exploit. Thus, a cut in taxes is necessary to force a reduction in expenditures to restore budgetary equilibrium. An alternative explanation championed by Buchanan *et al.* (1977) and Wagner (1976), argues that raising tax revenues reduce expenditures via fiscal illusion. In this case the public perceives the use of indirect taxation to finance expenditures as being cheaper than direct taxation even though they bear the costs via higher interest rates, private crowd-out, and inflation. For both explanations there is unidirectional causation running from revenues to expenditures.

Next, the spend-tax hypothesis states that the direction of causality runs from expenditures to revenues. For this hypothesis, expenditure decisions are made first then tax revenues are adjusted to meet those demands. According to Ricardian equivalence, advanced by Barro (1979), expenditures financed by deficits, ultimately lead to increases in tax revenues. Therefore, any increase in expenditures results in an increasing tax bill at some point in the future. In this case the way to reduce budget deficits is through expenditure cuts. Others such as Peacock & Wiseman (1979) declare that during periods of crisis the increase in spending leads to higher taxes that then become permanent.

The fiscal synchronization hypothesis stresses that revenues and expenditures are determined contemporaneously resulting in bidirectional causality. Musgrave (1966) and Meltzer & Richard (1981) argue that voters weigh the marginal benefits against the marginal cost of government programs when deciding the appropriate level of expenditures and revenues. Last, institutional separation results in the absence of causality since separate institutions make the revenue and expenditure decisions (Baghestani & McNown, 1994; Wildavsky, 1988).

Using different data sets, at both national and sub-national levels, and methodology, studies in this area provide mixed results with respect to the direction of causality.[20] The bulk of the empirical literature utilizes vector autoregressive or vector error correction models to ascertain directional causality. To a lesser extent focus on the sub-national level (e.g. US states) have been studied. Payne (1998) employs the Engle-Granger error correction model framework and analyzes the time series relationship between the forty-eight contiguous state and local governments for the period 1942 to 1992. He finds evidence of the tax-spend hypothesis for twenty-four states; the spend-tax hypothesis for eight states; the fiscal synchronization hypothesis for eleven states; and the remaining five states failed the diagnostic tests for error correction modeling. Earlier studies such as Marlow & Manage (1987, 1988) find unidirectional causality from tax revenues to expenditures at the state level with no evidence of directional causality at the local level. Chowdhury (1988) provides evidence of bidirectional causality between local revenues and expenditures. Ram (1988) finds unidirectional causality from expenditures to revenues using annual and quarterly data from the U.S.

More recently, Buettner & Wildasin (2006) examine the dynamic fiscal adjustment of local jurisdictions using a panel of over 1,000 US municipalities over 25 years within a vector error correction model framework. They find that expenditures re-

[20]For an extensive review of the revenue-expenditure nexus literature see Payne (2003).

spond to budgetary imbalances and, to a large extent, intergovernmental revenues play an integral role in financing imbalances, especially for larger cities. Westerlund *et al.* (2011) (WMF hereafter) are the first to use an error correction framework within a panel of U.S. state-local governments for the period 1963 to 1997. While controlling for a number of variables, including grants, they find evidence in favor of the tax-spend hypothesis. Specifically, WMF find that expenditures adjust to budgetary disequilibrium in the long run and also to short-run deviations in tax revenues, other funding sources, and output. In other words, the size of state-local governments is determined by resource supply rather than expenditure demand. Chowdhury (2011) also examines the revenue-expenditure nexus with respect to each state in the US and finds that forty percent of the states show an absence in causality between revenues and expenditures; eighteen percent support the spend-tax hypothesis; sixteen percent favor spend-tax hypothesis; and twenty-six percent show bidirectional causality between revenues and expenditures.

When focusing on sub-national governments grants from higher-level governments can have a significant impact on the tax and spending decisions of sub-national governments. Hines (2010) finds that balanced budget rules have very limited influence on state level spending, though intergovernmental grants continue to have a robust impact on state spending across different specifications. Moreover, grants not only have a significant effect on spending, but grants exhibit feedback from expenditures, thus confusing the direction of causality between grants and expenditures. For instance, states can rationally anticipate increases in transfers (i.e. bailouts) when debt levels are excessive and therefore choose debt levels that are too high (Poterba, 1995). In this case the direction of causality would run from federal transfers to debt through the use of either expenditures and/or taxes. Others have found that local governments choose inefficient policies intending to attract more transfers as part of a bailout package (Wildasin, 1997; Qian & Roland, 1998; Pettersson-Lidbom, 2010). For these reasons a more active look at the role served by grants is necessary when studying the tax-spend debate among sub-national governments within a federation.

This study expands the literature in a number of ways. This is the first study to examine the revenue-expenditure nexus using state-level panel data, as opposed to state and local combined, for over five decades within a panel error correction framework. Second, this study uses a stratified sample to explore differences relating to the revenue-expenditure nexus in order to better understand the mechanism behind significant debt accumulation among some states and not others. Third, the important role served by intergovernmental transfers within the revenue-expenditure nexus is closely examined. Fourth, the econometric technique used here circumvents problems of aggregation by allowing for heterogeneity in the short-run adjustments while constraining the long-run coefficients to be homogeneous, adhering to the long-run balanced budget constraint. In addition, cross-sectional dependence in controlled for to mitigate problems of identification and the short-run coefficients are estimated to ascertain short-run elasticities and adjustments. Finally, policy implications are provided based on the results.

4.3 The Empirical Model

The purpose of this study is to examine the dynamics of the intertemporal state government budget constraint, with the goal of testing the four aforementioned hypotheses. In other words, is the direction of causality (short run and long run) favorable for tax-spend, spend-tax, fiscal synchronization, or institutional separation? The long-run model of the intertemporal budget constraint can be represented by the following linear stochastic equation:

$$E_{it} = \alpha_i + \beta T_{it} + \delta G_{it} + \gamma^{'} X_{it} + \epsilon_{it} \tag{16}$$

where subscripts i and t indicate state and time period, respectively. The parameter α_i captures state fixed effects. The variables E_{it} and T_{it} represent total government expenditures and total tax revenues. G_{it} is intergovernmental transfers from the federal government (grants). X_{it} is a vector of control variables including, total debt outstanding, other revenues and personal income.[21] ϵ_{it} is the white noise error term. The parameter β gives the stimulative effect of tax revenues on expenditures and δ measures the extent that grants stimulate expenditures. As discussed in Chapter 1, the extent that the coefficient on grants is greater than the coefficient on income is commonly referred to as the "flypaper effect."

To examine the dynamics of the underlying intertemporal budget constraint the error correction model,

$$\Delta X_{it} = \alpha_i + \alpha_i t + \pi \hat{\epsilon}_{it-1} + \beta_j B^k \Delta X_{it-k} + u_{it} \tag{17}$$

is estimated, where ΔX_{it} is a vector including tax revenues, total expenditures, grants, income, debt, and other revenues. The backshift operator is given by B and k is the number of lags included in the error correction model. The variables α_i and $\alpha_i t$ control for state-fixed effects and state-specific time trends, respectively.[22] The short-run dynamics are provided by the lagged first differenced regressors of each variable and the short-run Granger-causality of each variable on each other can be tested by the joint significance of β_j in equation (17). The inclusion of $\hat{\epsilon}_{it-1}$ in each equation captures long-run budgetary imbalances and therefore the π coefficients represent the error correction process and adjustment to long-run budgetary equilibrium.[23] Specifically, the degree to which each variable adjusts back to equilibrium rests on

[21] Ideally, equation (16) would include gross state product (GSP), instead of personal income, to control for portions of tax revenue and spending that are sensitive to the level of economic activity; however, the GSP series includes a discontinuity at 1997 when the Bureau of Economic Analysis switched from calculating GSP using Standard Industrial Classifications industry definitions to the North American Industrial Classification System definitions.

[22] The lag length of the short-run adjustment terms in equation (17) is three which was determined, following WMF, using the following sieve approximation of Smith *et al.* (2004), $4(T/100)^{(2/9)}$.

[23] Note that $\hat{\epsilon}_{it-1}$ is the predicted residual from equation (16) lagged one period representing budget disequilibrium.

the significance of the respective error correction terms and the magnitude provides the speed and direction of the adjustment back to budgetary equilibrium.

4.4 Empirical Results for Full Sample

4.4.1 Data

The data consist of annual observations for a panel of the 48 contiguous US states over the period 1951 to 2008 collected from the Census Bureau's publication series "State Government Finances." Variables collected include total tax revenues, other revenues, federal government grants, total expenditures, total personal income, population, and total debt outstanding.[24] The variables are converted to real per capita terms and then converted to natural log.[25] Normalizing each variable by population controls for changes in taxes and spending due to changes in the population (e.g. migration and public demand). As suggested by Levin *et al.* (2002), cross-sectional averages were subtracted from each variable to mitigate the effect of cross-sectional dependence. Table 16 provides the summary statistics.

Table 16: Summary Statistics

Variable	Mean	Standard Deviation
Expenditures	1393.15	1793.40
Taxes	648.07	807.83
Grants	356.83	500.99
Income	10.12	12.15
Debt	796.92	1275.30
Other Revenues	509.17	728.28

Notes: Values are per capita 2005 dollars.

[24]State data, as opposed to aggregated state and local data, are used to separate out differences between state and local budget setting dynamics given that both state and local governments possess a high degree of fiscal autonomy.

[25]The price level used to normalize each variable is the GDP deflator collected from the Bureau of Economics Analysis.

4.4.2 Unit Root Tests

As is standard when testing for Granger causality the variables must be stationary and therefore a series of panel unit root tests are conducted using the Breitung (2000) test and the Hadri (2000) test. Both tests employ a simple autoregressive model given by (18).

$$y_{it} = a_{it} + \rho_i y_{i,t-1} + e_{it} \tag{18}$$

where y_{it} is total expenditures, tax revenues, total debt, grants, other revenues, or income; a_{it} can be either state fixed effects or a state-specific linear time trend; and ρ_i is the autoregressive parameter to be estimated. The Breitung test assumes that all panels contain a common ρ_i with a null hypothesis that the series contain a unit root, $\rho_i = 1$, and the alternative hypothesis that the series are stationary, $\rho_i < 1$. Although the Breitung test is optimal when all panels contain a common ρ_i, Breitung & Das (2005) state this test has power in the heterogeneous case as well. According to Hadri (2000), hypothesis testing requires strong evidence to the contrary in order to reject the null hypothesis. Thus, the Hadri test has as its null hypothesis that all panels are stationary against the alternative that at least some of the panels contain a unit root. The results of the two unit root tests, preformed with and without a time trend, are shown in Table 17.

Table 17: Unit Root Tests

	Breitung H_0:all panels contain unit roots		Hadri H_0:all panels are stationary	
	No Trend	Trend	No Trend	Trend
Exp	-0.95	-3.09***	53.42***	25.30***
ΔExp	-5.94***	-11.59***	-2.16	-0.92
Tax	-1.01	-0.42	51.59***	27.68***
ΔTax	-9.54***	-13.09***	-1.5	-1.4
Grants	0.25	0.83	59.07***	43.48***
ΔGrants	-6.75***	-14.14***	-0.28	-1.14
Inc	0.7	-1.65**	60.48***	25.49***
ΔInc	-4.28***	-10.54***	-0.88	-0.57
Debt	-0.35	-0.8	45.28***	32.97***
ΔDebt	-1.05**	-6.00***	0.73	3.62***
Other	-0.08	5.47	53.72***	23.56***
ΔOther	7.52***	1.37	-1.15	-0.52

Notes: The Breitung test includes 3 lags and The Hadri test uses the Prazen kernel to calculate long-run variances. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

In almost all cases, regardless of the inclusion of a linear time trend, the variables

are all non-stationary in levels, but stationary in first differences. Since the evidence suggests the variables are integrated to the same order (order one), it is possible that a linear combination of the variables are stationary representing an equilibrium relationship given by equation (16), thus the analysis proceeds to a formal test for cointegration.

4.4.3 Cointegration Estimates

Cointegration of the variables in equation (16) is evident of a long-run relationship between expenditures and the explanatory variables, namely, tax revenues, other revenues and grant revenues. To test for cointegration the Pedroni (1999, 2004) heterogeneous panel cointegration test is employed to determine whether equation (16) is indeed a cointegrating relationship. The Pedroni test is a residual based test similar to the Engle-Granger cointegration test, and is performed on the the residuals from equation (16), where the residuals represent instances of budgetary disequilibrium.[26] Equation (19) is used to test for the absence of cointegration ($\rho = 1$) against the alternative that equation (16) is cointegrating ($\rho < 1$).

$$\epsilon_{it}^{j} = \rho_i \epsilon_{it-1}^{j} + \omega_{it} \tag{19}$$

The Pedroni test reports seven statistics. The first four panel statistics (v, ρ, pp, adf) are within dimension based statistics. These statistics assume a common value for ρ by pooling all the $\rho's$ across the different members. The next three group statistics (ρ, pp, adf) are between dimension based statistics, which allow for heterogeneity across the individual cross-sections by averaging individual ρ coefficients for each state.

Table 18 shows the results for the corresponding panel cointegration tests. The statistics are distributed standard normal.[27] Notice that there is overwhelming evidence supporting the existence of cointegration since each of the seven statistics is significantly different from zero, thereby rejecting the null hypothesis of no cointegration.

Given significant evidence in favor of cointegration there are typically three estimators that have been used to estimate panel cointegrated models including, OLS, Dynamic OLS (DOLS), and Fully Modified OLS (FMOLS). However, according to Pedroni (2000), OLS estimates of the cointegrating vector is biased and its standard distribution depend on the nuisance parameters associated with the underlying short-run dynamics. FMOLS corrects the dependent variable using long-run covariance matrices to remove the nuisance parameters and then applies OLS to the corrected

[26] Cointegration among the variables in the budget constraint is a necessary condition for budget deficit sustainability (Quintos, 1995; Martin, 2000; Cuñado *et al.*, 2004).

[27] For more information on the the Pedroni panel cointegration test and calculations of the test statistics see Pedroni (1999).

Table 18: Pedroni's Heterogeneous Panel Cointegration tests

Panel v-statistic	3.74***
Panel ρ-statistic	-7.83***
Panel PP-statistic	-12.88***
Panel ADF-statistic	-10.81***
Group ρ-statistic	-6.87**
Group PP-statistic	-14.24***
Group ADF-statistic	-11.45***

Notes: All statistics are distributed standard normal and are weighted by long-run variances. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

variables. DOLS uses leads and lags of the differenced regressors to correct the nuisance parameters. Although, the limiting distributions of both DOLS and FMOLS are asymptotically normal as found by Kao & Chiang (2000), the finite sample properties of DOLS appear to be superior to both OLS and FMOLS. For example, Kao & Chiang (2000) find that in finite samples OLS contains a bias and FMOLS does not improve on OLS, thus DOLS may be the more promising estimator for estimating cointegrated panel models.[28] Given the superiority of DOLS over the competing estimation techniques, DOLS, augmented with one lead and lag of the differenced regressors, is used here to obtain estimates for the cointegrating vectors in equation (16). Adding leads and lags of the differenced regressors circumvents problem associate with endogenous feedback and serial correlation.[29] Table 19 provides the estimates for the cointegrating vectors.

Notice that the slope coefficients are positive and statistically significant, confirming the idea that expenditures at the state level are resource constrained. Consistent with the tax-spend hypothesis, increases in taxes lead to increases in expenditures. For example, a one percent increase in tax revenues increase expenditures by 0.42%. This estimate is close to that found by WMF (0.524). Interestingly, the coefficient on grants is significantly higher than personal income confirming the notion of the flypaper effect. A one percent increase in grants and income stimulate expenditures by 0.25% and 0.05%, repsectively. The coefficient on grants is much higher than that found by WMF (0.058), perhaps suggestive of the increasing reliance on grants

[28]See Caldern (2002) for more details. Also, see Kao *et al.* (1999) for a demonstration of the superiority of DOLS over FMOLS.

[29]It is assumed there exist only one cointegrating vector which is represented by the budget constraint and therefore expenditures are normalized to one for identification.

Table 19: Cointegration Estimates Using Dynamic Ordinary Least Squares

Expenditures	Estimate
Tax Revenues	0.419***
	[0.000]
Grants	0.247***
	[0.000]
Income	0.048**
	[0.045]
Debt	0.038***
	[0.000]
Other	0.221***
	[0.000]
Observations	2,784
Adj. R-Squared	0.688
Number of States	48

Notes: Probability values are in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1..

in finaincg expenditures post-1997. Furthermore, other revenues stimulate expenditures by 0.22% for every one percent increase in other revenues. The results from Table 19 provide the long-run equilibrium relationship among the variables and not the adjustment towards equilibrium. If grants respond to past changes in grants and expenditures this endogeneity distorts the flypaper effect as suggested by Bailey & Connolly (1998). To examine the short-run dynamics and adjustment towards budgetary equilibrium, the panel vector error correction model of equation (17) is estimated.

4.4.4 Short-Run Dynamics

To estimate the system of equations represented by equation (17), many rely on seemingly unrelated regressions (SURE) to allow for the contemporaneous error covariances to be freely estimated; however, given the large N and large T structure of the data SURE is not feasible (Pesaran *et al.*, 1999). Consequently, the mean-group estimator is used to estimate the short-run adjustment parameters, the error correction parameter and the error covariances. The mean-group estimator estimates each equation over each cross-section and creates an unweighted average of all the estimators, and therefore does not impose homogeneity restrictions; however, the long-run cointegrating vector is constrained to be equal across states.[30] Given the large N and

[30]Given that states are constrained by both constitutional as well as legislative requirements to maintain balanced budgets this is not an overbearing assumption.

large T dimension of the panel, the mean-group estimator gives a consistent estimate of the model parameters as shown by Pesaran & Smith (1995).[31] To construct the error correction model the panel analogue of the Engle & Granger (1987) two-step method is employed. The Engle & Granger (1987) two-step method involves augmenting the autoregressive distributed lag (ARDL) model with predicted residuals (lagged one period) from the long-run equation to obtain the error correction model.

Following the logic set forth by WMF, each equation represented by (17) is estimated separately to prevent from having to estimate all the parameters of the full panel error correction model, thus inferences are based on the conditional model only. According to WMF, this is feasible if the regression errors are independent of the explanatory variables at all leads and lags. This is not restricted based on the correctly specified model as long as the short-run dynamics are accounted for then the errors will be independent of the explanatory variables by construction (WMF). To examine the short-run Granger-causality of equation (17) the Wald test is used to test the joint significance of the lagged differenced variables in each equation. The short-run results are reported in Table 20.

Panel A of Table 20 reports the error correction term for each equation.[32] Notice expenditures, and not taxes, adjust to budget disequilibria. This result indicates unidirectional causality from taxes to expenditures, thus favoring the tax-spend hypothesis. However, debt, grants, income and other revenues respond to budget disequilibria, with other revenues exhibiting the fastest speed of adjustment. Panel B of Table 20 report short-run Granger-causality tests which reveal interesting patterns of causality. For instance, the absence of joint significance with respect to taxes in the expenditure equation and expenditures in the tax equation yield in favor of the institutional separation hypothesis. However, expenditures exhibit bidirectional causality with grants and other revenues. Also, there exists bidirectional causality between expenditures and debt. Though, the short-run estimates reported in Panel C of Table 20 reveal that a 1% increase in expenditures results in a 0.50% increase in total debt outstanding and the absence of feedback from debt.[33] Moreover, the positive and statstically signficant effect of taxes on grants and other revenues signfiy a complementarity relationship. Further, a 1% increase in grants increase other revenues by 0.15%, which is consistent with Leviathan behavior. There also appears to be negative inertia with respect to tax policy as the accumulated effect of tax revenues on contemporaneous taxes are negative and this result applies to both grants and other revenues as well. Alternatively, expenditures appear to be independent from past expenditures.

The above analysis indicates clear evidence in favor of the tax-spend hypothesis

[31] Each specification includes a group-specific time trend and the estimates are the outlier-robust mean of the parameter coefficients across groups.

[32] The error term represents budget disequilibrium. Construction of the error correction term, from equation (16), is such that positive error terms signify budget deficits and negative error terms indicate budget surplus.

[33] Short-run estimates are calculated as the sum of the coefficients on the lagged differences and the standard errors are calculated using the "delta method."

Table 20: Long-Run Error Correction & Short-Run Dynamics

Variables	(1) Expenditures	(2) Tax	(3) Grants	(4) Income	(5) Debt	(6) Other
Panel A: Long-Run Error Correction						
ϵ_{t-1}	-0.297***	0.024	0.154**	-0.047***	0.186**	0.419***
	(0.028)	(0.037)	(0.071)	(0.016)	(0.083)	(0.091)
Panel B: Wald Test of Short-Run Causal Dynamics						
$H_0 : exp_{t-1} = exp_{t-2} = exp_{t-3} = 0$						
F-stat	0.864	0.023	9.970**	4.664	9.143**	7.470*
	[0.834]	[0.999]	[0.019]	[0.198]	[0.027]	[0.058]
$H_0 : tax_{t-1} = tax_{t-2} = tax_{t-3} = 0$						
F-stat	2.368	75.205***	12.388***	0.637	2.071	4.551
	[0.500]	[0.000]	[0.006]	[0.888]	[0.558]	[0.208]
$H_0 : grant_{t-1} = grant_{t-2} = grant_{t-3} = 0$						
F-stat	22.025***	1.248	142.283***	2.923	1.183	4.792
	[0.000]	[0.741]	[0.000]	[0.404]	[0.757]	[0.188]
$H_0 : inc_{t-1} = inc_{t-2} = inc_{t-3} = 0$						
F-stat	2.973	29.729***	3.011	2.531	4.861	14.157***
	[0.396]	[0.000]	[0.390]	[0.470]	[0.182]	[0.003]
$H_0 : debt_{t-1} = debt_{t-2} = debt_{t-3} = 0$						
F-stat	17.169***	4.647	3.288	0.495	17.191***	10.457**
	[0.001]	[0.200]	[0.349]	[0.920]	[0.001]	[0.015]
$H_0 : other_{t-1} = other_{t-2} = other_{t-3} = 0$						
F-stat	44.821***	2.023	3.157	1.110	2.915	157.948***
	[0.000]	[0.568]	[0.368]	[0.775]	[0.405]	[0.000]
Panel C: Accumulated Short-Run Estimates						
Expenditures	0.035	-0.006	-0.096	-0.023	0.501***	-0.395**
	(0.061)	(0.069)	(0.111)	(0.028)	(0.170)	(0.153)
Taxes	0.026	-0.420***	0.257***	-0.011	-0.139	0.279**
	(0.045)	(0.054)	(0.093)	(0.017)	(0.130)	(0.133)
Grants	-0.129***	0.009	-0.580***	0.007	-0.010	0.152**
	(0.028)	(0.030)	(0.054)	(0.010)	(0.089)	(0.073)
Income	0.180	0.690***	0.103	-0.038	-0.555	1.175***
	(0.114)	(0.153)	(0.265)	(0.059)	(0.371)	(0.350)
Debt	0.033*	0.011	0.003	0.005	0.035	0.071*
	(0.018)	(0.018)	(0.030)	(0.007)	(0.057)	(0.038)
Other Revenues	-0.103***	0.005	0.047	-0.002	0.088*	-0.795***
	(0.015)	(0.021)	(0.031)	(0.007)	(0.052)	(0.066)
Observations	2,592	2,592	2,592	2,592	2,592	2,592
Number of States	48	48	48	48	48	48

Notes: Standard errors in parentheses and probability values in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1..

brought forth by Friedman (1978) in the long run. However, other revenues appear to bear the majority of the adjustment burden back to equilibrium. The combination of grants responding to budget disequilibria illustrate the importance of grants in maintaining a balanced budget. Alternatively, in the short run, there exists no discernible causal relationship between expenditures and taxes, which favors the institutional sep-

aration hypothesis. Consequently, states appear to place more emphasis on financing expenditures through grants and other revenues. This behavior is consistent with evidence by Skidmore (1999) that localities under fiscal restraints have a tendency to shift to other revenues and away from tax revenues.

Overall, budgetary dynamics resemble strikingly different patterns of adjustment in both the short and long run, therefore policy recommendations must coincide with these differences taking into consideration different state subtleties. Austerity measures in the short run should include some combination of tax and expenditure adjustments and perhaps even reconnecting the tax-spend nexus to avert potential budget shortfalls; however long-run austerity measures should include adjusting taxes. According to Friedman (1978) any increase in tax revenue would lead to increases in expenditures and so the best way to cut spending and balancing the budget is through reducing revenue resources. The use of federal aid by states in maintaining a balanced budget might warrant the federal government to assist in paying down debt levels and encouraging balanced budgets by spreading the cost among all the states in the union. However, caution should be given as not to encourage moral hazard on the side of the states, which would result in further problems in the long run.[34] Finally, the use of debt in financing short-run expenditures should be curtailed as to inhibit significant debt accumulation over time.

4.5 High Debt versus Low Debt States

The assumption so far has been that all states follow a common fiscal adjustment process; however, incentives for fiscal adjustment may differ significantly across states for reasons such as politics. The surge in budget shortfalls among states, even in the presence of constitutional and legislative constraints, warrants an examination of possible asymmetries relating to states with lower debt levels versus states with higher debt levels. In this section, heterogeneity relating to the revenue-expenditure nexus is compared and contrasted between high debt states and low debt states. The results shed light on possible explanations for the evolution of large unsustainable debt levels among certain states. Therefore, to check the robustness of the above results, the sample is split based on the debt-to-population ratio to ascertain differences among high versus low debt states relating to budgetary dynamics. To split the sample, the state-specific mean of the debt-to-population ratio was determined for each state and then the sample was split based on the median to ensure the same number of cross-sections in each sample. States corresponding to each sample split are reported in Table 21.[35]

[34] See Poterba (1995) for more discussion on the relationship between indebtedness and intergovernmental transfers.

[35] It is interesting to note that among high debt states sixteen were classified as blue states, seven were red states and one was a purple (swing) state, whereas low debt states were comprised of fourteen red states, four blue states and six purple states. Estimates from Wikipedia were used to determine state color. These were based on compiling the average margins of victory in the presidential elections between 1942 to 2008.

Table 21: Stratified Samples

High Debt States		Low Debt States	
CA	NM	AL	MS
CT	NY	AZ	MO
DE	ND	AR	NE
IL	OR	CO	NV
KY	RI	FL	NC
LA	SC	GA	OH
ME	SD	ID	OK
MD	VT	IN	PA
MA	WA	IA	TN
MT	WV	KS	TX
NH	WI	MI	UT
NJ	WY	MN	VA

Summary statistics for each sample split are found in Table 22. Interestingly, high debt states have higher levels of expenditures and federal grants compared to low debt states.

Table 22: Summary Statistics for Sample Splits

	Mean	Standard Deviation	Minimum	Maximum
High Debt States				
Expenditures	1557.52	1990.58	10.14	10352.17
Taxes	698.92	882.03	5.27	4899.13
Grants	402.53	563.99	0.98	4069.20
Income	10.52	12.75	0.17	61.07
Debt	1133.96	1611.44	0.04	11928.84
Other Revenues	588.59	826.33	1.78	7064.07
Low Debt States				
Expenditures	1228.78	1555.12	10.06	7116.39
Taxes	597.23	722.83	6.01	3802.95
Grants	311.14	424.15	1.33	3260.43
Income	9.73	11.50	0.13	47.86
Debt	459.88	655.61	0.10	3593.07
Other Revenues	429.75	604.74	1.41	4188.72

Notes: Values are per capita 2005 dollars. Each group has 1392 observations.

4.5.1 Cointegration

Table 23: Pedroni's Heterogeneous Panel Cointegration Tests

	High Debt	Low Debt
Panel v-statistic	2.78***	2.51**
Panel ρ-statistic	-5.16***	-5.90***
Panel PP-statistic	-8.51***	-9.69***
Panel ADF-statistic	-7.52***	-7.77***
Group ρ-statistic	-4.56***	-5.15***
Group PP-statistic	-9.56***	-10.58***
Group ADF-statistic	-8.24***	-7.96***

Notes: All statistics are distributed standard normal and are weighted by long run variances. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

Results from the Pedroni's cointegration tests for each sample are given in Table 23. Consistent with the full sample, both samples exhibit statistically significant evidence in favor of cointegration, which is consistent with the weak form of budget deficit sustainability.

Table 24: Cointegration Estimates Using Dynamic Ordinary Least Squares

Variable	High Debt	Low Debt
Taxes	0.397***	0.479***
	[0.000]	[0.000]
Grants	0.248***	0.230***
	[0.000]	[0.000]
Income	0.057***	-0.008***
	[0.084]	[0.412]
Debt	0.038***	0.024***
	[0.000]	[0.000]
Other Revenues	0.204***	0.227***
	[0.000]	[0.000]
Observations	1,392	1,392
R-Squared	0.811	0.908
Number of States	24	24

Notes:Proabaility values are in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

DOLS estimation is used to estimate the cointegrating equation for each sample split which uncovers interesting disparities that exist between high debt and low debt states as shown in Table 24. For instance, low debt states rely more heavily on tax revenues to finance expenditures as compared to high debt states. A 1% increase in tax revenues increase expenditures by 0.48% in low debt states and only 0.40% in high debt states. On the other hand, a 1% increase in grants increases expenditures by 0.25% for high debt states and only 0.23% in low debt states. Low debt states also appear to rely more heavily on other revenues to finance expenditures with an elasticity of 0.20 compared to 0.23 for high debt states. Overall, the long-run estimates show differences in the revenue-expenditures nexus related to debt levels in the long-run, the next section provides estimates of the short-run adjustments for low and high debt states.

4.5.2 Short-Run Results

The short-run dynamics for low debt states and high debt states are given in Table 25 and 26, respectively. Results for the low debt states in Panel A of Table 25 show that both expenditures and tax revenues respond to budget disequilibria, thus favoring the synchronization hypothesis. Also, other revenues adjust to budget disequilibrium and bear the majority of the adjustment burden, whereas debt and grants show signs of weak exogeneity given their lack of adjustment to disequilibrium. Panel B and C of Table 25 provide results for the tests of Granger causality and accumulated short-run estimates. Consistent with the full sample, the short-run Granger-causality results favor the institutional separation hypothesis given by the absence of a causal relationship between taxes and expenditures in each equation as shown in columns 1 and 2, respectively. Interestingly, debt is not effected by expenditures and even decreases with increases with tax revenues (although this is not significant at conventional levels). There also appears to be a complementarity among other revenues and grants as shown by the positive relationship shown in Panel C, which consistent with the full sample. With respect to persistence, taxes exhibit negative inertia given by the negative and significant accumulative effect of lagged taxes on contemporaneous taxes in column 2 and expenditure exhibit an absence of inertia as shown in column 1.

Focusing our attention on states with high debt levels, Table 26 reveals strikingly different patterns of budgetary dynamics in the short and long run. As opposed to low debt states, long-run adjustment favors the tax-spend hypothesis as expenditures adjust to budgetary disequilibrium and taxes reveal signs of weak exogeneity. Also, expenditures, and not other revenues, bear the majority of the adjustment burden. Remaining robust across samples is the lack of a causal relationship between taxes and expenditures in the short run and that other revenues and expenditures bear the majority of the adjustment burden. Surprisingly, there exhibits negative inertia with respect to taxes and positive inertia with respect to expenditures, as shown in Panel C of Table 26, suggesting a divergence in short-run revenue-expenditure policies. Conceivably, this break in the revenue-expenditure nexus and the divergence between

Table 25: Low Debt: Long-Run Error Correction & Short-Run Dynamics

VARIABLES	(1) Expenditures	(2) Tax	(3) Grants	(4) Income	(5) Debt	(6) Other
Panel A: Long-Run Error Correction						
ϵ_{t-1}	-0.285***	0.089**	0.116	-0.051**	0.180	0.724***
	(0.052)	(0.043)	(0.105)	(0.024)	(0.171)	(0.182)
Panel B: Wald Test of Short-Run Causal Dynamics						
$H_0 : exp_{t-1} = exp_{t-2} = exp_{t-3} = 0$						
F-stat	3.432	3.350	9.328**	3.150	1.261	19.189***
	[0.330]	[0.341]	[0.025]	[0.369]	[0.738]	[0.000]
$H_0 : tax_{t-1} = tax_{t-2} = tax_{t-3} = 0$						
F-stat	3.083	27.089***	6.737*	2.128	5.716	2.399
	[0.379]	[0.000]	[0.081]	[0.546]	[0.126]	[0.494]
$H_0 : grant_{t-1} = grant_{t-2} = grant_{t-3} = 0$						
F-stat	14.822***	0.006	83.448***	3.569	2.066	7.305*
	[0.002]	[1.000]	[0.000]	[0.312]	[0.559]	[0.063]
$H_0 : inc_{t-1} = inc_{t-2} = inc_{t-3} = 0$						
F-stat	2.986	25.369***	1.531	3.242	7.584*	9.921**
	[0.394]	[0.000]	[0.675]	[0.356]	[0.055]	[0.019]
$H_0 : debt_{t-1} = debt_{t-2} = debt_{t-3} = 0$						
F-stat	9.501**	0.583	0.977	2.020	13.268***	11.859***
	[0.023]	[0.900]	[0.807]	[0.568]	[0.004]	[0.008]
$H_0 : other_{t-1} = other_{t-2} = other_{t-3} = 0$						
F-stat	18.244***	10.889**	5.510	4.864	7.164*	71.309***
	[0.000]	[0.012]	[0.138]	[0.182]	[0.067]	[0.000]
Panel C: Accumulated Short-Run Estimates						
Expenditures	-0.087	-0.085	-0.175	0.005	0.290	-0.964***
	(0.084)	(0.093)	(0.162)	(0.040)	(0.314)	(0.227)
Tax	0.002	-0.301***	0.166	-0.034	-0.361	0.246
	(0.063)	(0.073)	(0.121)	(0.027)	(0.229)	(0.159)
Grants	-0.163***	-0.003	-0.625***	0.013	0.104	0.307***
	(0.042)	(0.043)	(0.077)	(0.014)	(0.158)	(0.115)
Income	0.244	0.762***	-0.113	-0.100	-1.465***	1.382***
	(0.160)	(0.202)	(0.386)	(0.090)	(0.565)	(0.478)
Debt	0.032***	0.001	0.003	0.011	-0.012	0.055
	(0.019)	(0.022)	(0.034)	(0.009)	(0.080)	(0.041)
Other	-0.083***	0.060***	0.074*	0.012	0.243***	-0.825***
	(0.020)	(0.022)	(0.038)	(0.008)	(0.093)	(0.099)
Observations	1,296	1,296	1,296	1,296	1,296	1,296
Number of States	24	24	24	24	24	24

Notes: Standard errors in parentheses and probability values in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

taxes and expenditures may perhaps result in unsustainable revenue-expenditure policies that could set the stage for generating considerable amounts of debt over time. Moreover, opposed to low debt states, increases in expenditures cause increases in debt by approximately 0.77% for every 1% increase in expenditures, as shown in column 5 of Panel C. High debt states rely on federal aid, as opposed to own revenues, to offset debt increases, as shown in column 5, such that a 1% increase in federal aid reduces debt by 0.15%. From this result one could infer that low debt states are to a certian degree subsidizing high debt states. As Wildasin (2010) points out, grants

can "weaken local fiscal discipline" if localities perceive ever increasing grants that then result in unsustainable revenue-expenditure policies. As is shown, grants play a much larger role in the revenue-expenditure nexus for high debt states than low debt states.[36] These contrasting results shed light on possible explanations for the large debt accumulation across many states. Specifically, the combination of the lack of causal dynamics between taxes and expenditures, the divergence between tax and expenditure policies in the short-run and states' reliance on grants to finance debt, are all conducive to debt accumulation.

Results from the stratified sample reveal significant differences in the dynamics between high debt and low debt states. High debt states rely on riskier budget setting dynamics given the lack of response from tax revenues to budgetary shortfall, whereas low debt states display more fiscal prudent budgetary dynamics in that both expenditures and taxes respond to budgetary shortfalls. Furthermore, the the short-run divergence between tax and expenditure policies in high debt states exacerbates the break in the revenue-expenditure nexus further causing problems maintaining a balanced budget. Also, the role of federal grants in high debt states –as opposed to taxes or other revenues directly controlled by state governments–serve to retire debt obligations, which demonstrates the reliance on the federal government to finance debt.

Policy makers need to take these disparities into account when formulating policies relating to state-level budgets. In particular, the evidence suggests that grants are potentially creating a moral hazard since they are largely used to pay down debt among high debt states, therefore grants need to be continuously reevaluated in order to minimize moral hazard. Also, policy makers in high debt states need to focus on establishing the short-run nexus between tax revenues and expenditures by reversing the current divergent paths of taxes and expenditures in order to promote a long-run sustainable path. Policy makers in low debt states should also focus on establishing the link between taxes and expenditures in order to maintain control in balancing their budgets, but long-run goals should be a combination of tax and expenditure adjustments.

Overall, the budgetary dynamics suggest significant heterogeneity among states with respect to adjustments in tax revenues and expenditures in both the short run and long run. However, there are some similarities among all samples. For instance, in all samples long-run adjustment occurs through expenditures and other revenues. This result remains robust to sample splits and suggests that states under constitutional and legislative constraints rely on other revenues to maintain a balanced budget. Also, the lack of causal relationships between taxes and expenditures in the short run remains robust across sample splits. Conceivably, this break in the revenue-expenditure nexus could result from a number of issues relating to state finances (e.g. public pensions) and then exacerbated by the current recession as tax revenues de-

[36]Interestingly, high debt states have a much larger average population density compared to low debt states suggesting high debt states are more urban like. According to Buettner & Wildasin (2006), larger citities are be able to lobby higher level governments for fiscal assistance or other special treatments.

Table 26: High Debt: Long-Run Error Correction & Short-Run Dynamics

VARIABLES	(1) Exp	(2) Tax	(3) Grants	(4) Inc	(5) Debt	(6) Other
Panel A: Long-Run Error Correction						
ϵ_{t-1}	-0.340***	0.001	0.114	-0.043*	0.112	0.286**
	(0.037)	(0.063)	(0.091)	(0.023)	(0.081)	(0.113)
Panel B: Wald Test of Short-Run Causal Dynamics						
$H_0 : exp_{t-1} = exp_{t-2} = exp_{t-3} = 0$						
F-stat	5.484	0.773	3.309	4.040	22.579***	1.633
	[0.140]	[0.856]	[0.346]	[0.257]	[0.000]	[0.652]
$H_0 : tax_{t-1} = tax_{t-2} = tax_{t-3} = 0$						
F-stat	0.321	42.182***	7.573*	1.395	0.200	2.066
	[0.956]	[0.000]	[0.056]	[0.707]	[0.978]	[0.559]
$H_0 : grant_{t-1} = grant_{t-2} = grant_{t-3} = 0$						
F-stat	9.065**	3.293	61.426***	0.286	3.046	1.394
	[0.028]	[0.349]	[0.000]	[0.963]	[0.385]	[0.707]
$H_0 : inc_{t-1} = inc_{t-2} = inc_{t-3} = 0$						
F-stat	2.502	9.562**	2.676	5.261	1.651	4.055
	[0.475]	[0.023]	[0.444]	[0.154]	[0.648]	[0.256]
$H_0 : debt_{t-1} = debt_{t-2} = debt_{t-3} = 0$						
F-stat	7.187*	11.236**	1.741	1.461	5.962	3.576
	[0.066]	[0.011]	[0.628]	[0.691]	[0.113]	[0.311]
$H_0 : other_{t-1} = other_{t-2} = other_{t-3} = 0$						
F-stat	29.714***	4.016	2.069	5.722	0.946	107.264***
	[0.000]	[0.260]	[0.558]	[0.126]	[0.814]	[0.000]
Panel C: Accumulated Short-Run Estimates						
Expenditures	0.171**	-0.010	0.050	-0.061	0.771***	0.060
	(0.086)	(0.104)	(0.152)	(0.038)	(0.173)	(0.206)
Taxes	0.010	-0.516***	0.300**	0.011	-0.018	0.300
	(0.066)	(0.084)	(0.144)	(0.022)	(0.139)	(0.212)
Grants	-0.104***	0.038	-0.539***	0.002	-0.152*	-0.019
	(0.037)	(0.045)	(0.074)	(0.014)	(0.090)	(0.085)
Income	0.102	0.545***	0.327	0.029	-0.126	0.858
	(0.158)	(0.202)	(0.386)	(0.074)	(0.468)	(0.527)
Debt	0.044	0.026	0.011	-0.001	0.083	0.091
	(0.031)	(0.030)	(0.051)	(0.011)	(0.084)	(0.067)
Other Revenues	-0.124***	-0.049	0.026	-0.017	-0.047	-0.785***
	(0.024)	(0.034)	(0.048)	(0.011)	(0.056)	(0.088)
Observations	1,296	1,296	1,296	1,296	1,296	1,296
Number of States	24	24	24	24	24	24

Notes: Standard errors in parentheses and probability values in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1..

clined due to the decrease in household wealth, increased savings among individuals and sluggish economic growth. Thus, going forward, establishing the link between short-run taxes and expenditures should be of primary concern for policy makers.

4.6 Concluding Remarks

Mounting budget deficits by US states can be explained by the budget setting behavior of political officials. Using a panel of US states over five decades, the results in this

study suggest differences in the short and long-run behavior of fiscal adjustment. Short-run dynamics favor the institutional separation hypothesis; however, long-run adjustment primarily occurs through expenditures along with adjustments by both grants and other revenues. This result favors the tax-spend hypothesis in which tax revenues encourage expenditures in the long run. These results highlight the importance of recognizing disparities in the revenue-expenditure nexus along with the importance of federal aid, that need to be accounted for to ensure the enactment of policies that are favorable for budget sustainability.

Results from the stratified sample based on the debt-to-population ratio, reveal distinct causal relationships between tax revenues and expenditures. The short-run and long-run evidence signal significant heterogeneity. For example, in the short run, both low debt and high debt states favor the the institutional separation hypothesis; however, with respect to high debt states, tax and expenditure policies are diverging thus exacerbating the break in the revenue-expenditure nexus. Moreover, low debt states appear rely on tax revenues to decrease debt levels in the short-run whereas high debt states instead rely on federal aid. These results are consistent with the idea that high debt states display more precarious budget setting dynamics which could explain their potentially risky debt position relative to low debt states. Furthermore, high debt states should relieve their reliance on grants and instead focus on being more autonomous by relying more on own revenue sources.

The diverse dynamics among samples unveil important policy implications. As state budget deficits intensify the correct action to rectify budgetary imbalances depends on the causal linkages between revenues, expenditures and grants. For instance, establishing the short-run nexus between taxes and expenditures would be appropriate to correct short-run budgetary imbalances and avert unsustainable debt accumulation, but a long term approach should include adjustments in tax revenues. Specifically, in order to effectively shrink state budgets, permanent tax cuts would be necessary to force spending cuts. On the other hand, policies in high debt states aimed at controlling budget deficits should focus on reversing the time paths of tax revenues and expenditures to further prevent unsustainable budget paths, while long-run policies should focus adjusting taxes to reduce state budgets. For low debt states, along with establishing the short-run relationship between taxes and expenditures, focus should be on adjusting both expenditures and tax revenues to correct for budgetary imbalances in the long run. The role of grants in offsetting debt for high debt states sheds light on the federal government's role in securing budgetary equilibrium in the short run. State reliance on these grants as a means of retiring debt obligations can exacerbate risky behavior, as high debt states rely more heavily on grants than low debt states, thus the moral hazard attributes of grants should be examined more carefully. Perhaps a more efficient strategy over the long-run for all states would be to substitute away from federal grant financing and toward a devolution of taxing responsibilities down to states. This strategy should effectively "harden" state budgets and invoke tax competition that would, in theory, drive down tax rates and, according to the results in this chapter, reduce spending (See Rodden *et al.*, 2003 for a more thorough discussion).

5 An Empirical Investigation of Fiscal Interactions and the Flypaper Effect

5.1 Introduction

Many researchers have assumed that governments make decisions in isolation; however, recent research has shown that the activities of other governments both horizontally and vertically play a very active role in the decision making process. In understanding state level spending behavior it is important to account for the feedback from the activities of other governments within a federation. Of course there are many reasons for accounting for such activities. For instance, states' fiscal decisions impose externalities on their neighbors by encouraging the mobility of the factors of production which ultimately influences the tax base, or neighboring state fiscal policies can serve as informational externalities in the form of yardstick competition. The literature on the flypaper effect outlined in Chapter 1 has, for the most part, disregarded the externalities imposed by neighboring governments and instead assumed these governments decide on the optimal level of public spending in isolation. However, if the median voter benefits from neighboring jurisdictions' public spending or use the fiscal policies in neighboring jurisdictions as a mechanism for evaluating current policy maker performance then actions of neighboring jurisdictions will be an important determinant of public spending. According to Hines & Thaler (1995), for instance, failure to account for decisions made by other jurisdictions is one reason behind finding a flypaper effect. Furthermore, Case *et al.* (1993) also believe that the size of the flypaper effect can be attributed to these spillovers by neighboring states. Indeed, Acosta (2010) uses data from Argentina and finds evidence that ignoring spatial interdependence overestimates the flypaper effect.

The purpose of this study is to better understand the flypaper effect as it relates to state level spending. Addressing the current omissions in the literature as described by Inman (2008), such as omitted variables relating to neighboring state fiscal policies, this study sheds light on the determinants of the flypaper effect. Specifically, fiscal interactions with respect to expenditures and grants, proves to be an important omission when estimating the flypaper effect. Federal grants are shown to have important informational externalities that inform voters and policy makers on the behavior of neighboring state policies that then influence their own state's fiscal policies. Furthermore, public services in neighboring states can emit significant spillover benefits thereby effectively linking public spending levels across states. Case *et al.* (1993) offer a number of examples of this such as, spending on highways that provide benefits to neighboring residents that use these roads; school expenditures that can benefit neighboring states as well-educated people migrate to these states or compete with workers in other states; and residents in one state could benefit from neighboring states' welfare expenditures provided they care about the poor.

In the wake of fiscal federalism, policy makers and researchers are becoming aware of the importance in understanding the dynamic nature of fiscal policy adjustment to changes in other government fiscal policies, both horizontally and vertically. Therefore, in addition to accounting for fiscal interactions this chapter relaxes the assumption of instantaneous adjustment and instead allows for partial adjustment in public

spending levels. Indeed, the mobility of resources following changes in state fiscal policy necessitates a dynamic framework to allow for adjustment time. In fact, estimation of a reaction function implicitly assumes dynamic responses by states to rival state activities, yet most studies instead estimate a steady-state reaction function (Baicker, 2005). Finally, in this chapter I use a relatively new econometric technique to address the issue of endogeneity and that is conducive to studying the underlying dynamics. Overall, the results yield in favor of a strong flypaper effect; however, the flypaper effect appears to be generated from omitted variable bias resulting from ignoring fiscal interactions in the form of yardstick competition and budget spillovers.

The remainder of this chapter is structured as follows: Section 5.2 documents the current literature; Section 5.3 discusses the theoretical foundation; Section 5.4 outlines the data and methodology; Section 5.5 provides the results; and concluding remarks are given in the final section.

5.2 Strategic Interactions and the Flypaper Effect

The flypaper effect has been a robust finding in the literature. Table 27 provides estimates of early empirical estimates of the flypaper effect. These range anywhere from 0.40 to 1.00, whereas the propensity to spend out of community income ranges from 0.05-0.10. Using similar data to this study, Case *et al.* (1993) find that the propensity to spend grant money is 0.65. The empirically strategy as well as the data vary across studies, but consistently find evidence of the flypaper anomaly.

Table 27: Summary of the Flypaper Effect

Author	Sample	Estimate
Inman (1971)	Panel study of 41 city budgets	1.00
Weicher (1972)	State aid to 106 municipal governments	0.90
Weicher (1972)	State grants to independent school districts	0.40
Gramlich and Galper (1973)	Federal grants to local and state governments	0.43
Gramlich and Galper (1973)	Federal and state aid to 10 large urban governments	0.25
Bowman (1974)	Federal education grants to West Virginia school districts	1.06
Bowman (1974)	State grants to West Virginia school districts	0.50
Feldstein (1975)	State grants to Massachusetts towns	0.60
Olmsted, Denzau and Roberts (1993)	Missouri state aid to local school districts	0.58
Case, Hines and Rosen (1993)	Federal grants to 48 states, 1970-1985	0.65

Source: This table is a replica of Table 1 found in Hines & Thaler (1995).

According to the relatively recent literature on fiscal federalism there is ample evidence to suggest extensive governmental interaction, both horizontally and vertically.[37] Of course, these interactions can be passive in that the actions by one jurisdiction do not intentionally affect their neighbors or they could be active in which governments utilize a strategic set of policy instruments to attract the mobile tax bases. Brueckner (2003) classifies the two aforementioned cases as either "resource flow" models or "spillover" models, where the former refers to models of fiscal competition and the latter as fiscal externalities (e.g. yardstick competition). Two possible explanations for such interactions include the exit mechanism and the

[37]For an overview of empirical studies concerning fiscal strategic interactions consult Brueckner (2003).

vote mechanism. Tiebout (1956) argued that efficient levels of public services can be generated through households sorting themselves among heterogeneous jurisdictions that provide public goods and corresponding tax prices that match their preferences. The ability of households to "vote with their feet" (i.e. the exist mechanism) is the mechanism through which governments can compete for mobile households by lowering the tax price of public services relative to their neighbor. However, it has been warned that this behavior encourages a "race to the bottom" in tax rates and, subsequently, sub-optimal levels of public goods. Numerous studies have been carried out to examine the effect of tax competition within a theoretical framework such as Zodrow & Mieszkowski (1986) ,Wilson (1986), and Wildasin (1991).[38]

Using spatial econometric methods, reaction functions have been estimated with respect to both tax rates and expenditures. For instance, focusing on the US, Baicker (2005) found that for each $1 increase in neighboring state expenditures, own-state expenditures increased by $0.90; with the degree of population mobility being most predictive measure of neighborliness. Others have found similar upward sloping reaction functions with respect to tax rates. For example, Buettner (2001) examines local business taxes in Germany; Brueckner & Saavedra (2001) focuses on property tax rates in the Boston area; and Brett & Pinkse (2000) look at local property taxes in British Columbia. Others, such as Ladd (1992) and Revelli (2001), find additional evidence of strategic behavior among localities.

Another possible mechanism for state interaction is that of yardstick competition, resulting from the vote mechanism. In this case, expenditure mimicking behavior is tied to the political process. This idea, first expressed by Salmon (1987), claims that since voters do not know the production function for public goods they rely on fiscal policies in neighboring jurisdictions as a benchmark. If the voters find that the expenditure levels (or tax rates) in their jurisdiction is set significantly above that of their neighbors they will be inclined to vote that politician out of office. Rational politicians will therefore mimic their neighbor's fiscal policies to prevent from being voted out of office. Case (1993) was the first to study the potential source of tax mimicking. With respect to the US, Case (1993) finds positive strategic interaction among tax rates of neighboring jurisdictions when the governor is up for re-election. Also, Besley & Case (1995a) find that tax rates are only affected by neighboring tax rates when the governor is eligible for re-election. They find that the probability of a governor being unseated increases with increases in tax rates of their own jurisdiction and falls when tax rates in neighboring jurisdictions increase.

Although most of the literature to date has focused on either tax competition or yardstick competition, there is little research done on the role of intergovernmental transfers in a strategic interactive environment. When states are part of a fiscal union, as in the US, transfers have the potential to alter the incentives faced by policy makers under fiscal competition. For example, transfers are typically used to mitigate horizontal externalities imposed by tax competition; however, states can alter their policy instruments to attract more federal funds. Kothenburger (2004) shows that states can "see-through" the federal transfer policy and perceive transfers

[38]For a review of the literature on fiscal competition see Wilson (1999).

to depend on expenditures or tax rates. Consequently, governments could select inefficient policies in order to attract discretionary fiscal funds (see, e.g., Wildasin, 1997; Qian & Roland, 1998; Pettersson-Lidbom, 2010).

When dealing within a multi-tiered system, vertical interactions become increasingly important as externalities can develop from upper tiered governments as previously described. With few exceptions most of the studies to date examine only the effect of own-state federal grants on own-state expenditures and disregard the horizontal fiscal linkages that may distort this relationship. To fill this void, Boarnet & Glazer (2002) use data on the forty-eight contiguous states from 1970 to 1985 and find strong evidence in favor of grants awarded to neighboring states serving as a yardstick mechanism for which citizens use to evaluate policy makers. Consequently, grants awarded to neighboring states reduce own-state expenditures. The evidence provided by Boarnet & Glazer (2002) suggests that federal grant awards provide valuable information that inform voters about the competence or ability of their government relative to other governments in the form of yardstick competition. Alternatively, Kothenburger (2004) finds that besides tax and yardstick competition, transfers offer a third channel of interaction that is capable of explaining expenditure (or tax rate) interactions among subnational governments. For instance, equilibrium expenditures can be generated by federal transfers even in the presence of capital mobility. Both cases highlight the importance of grants serving as a means of linking local governments within a federation. If fiscal interactions are present and influence own-state expenditures then failure to a account for these interactions will overstate the stimulative effect of grants on expenditures. Therefore, grant income received by neighboring states effectively serve to constrain state government spending by informing the median voter on the performance of their policy makers.

This chapter exploits the horizontal and vertical interactions among governments in the US in order to examine the relationship between federal grants and state level expenditure policy. Following Case *et al.* (1993), state governments are assumed to spatially interact over expenditures to account for budget spillovers from neighboring jurisdictions. Furthermore, the informational externalities associated with federal grants are accounted for following Boarnet & Glazer (2002), which assumes the median voter uses federal grants awarded to neighboring states as a yardstick for gauging the performance of their own policy makers. The next section generates the median voter model augmented with spillover externalities.

5.3 Theoretical Model

The state government is assumed to maximize the utility of the median voter,

$$\max U(x, g_i) \tag{20}$$

subject to the median voter's budget constraint:

$$Y_i = I_i + h * z_i = x + p_g * g_i \tag{21}$$

where x is the private good; g_i is the public good in state i; I is private income (tax base); and h is the median voter's share of the transfers z_i. The price of private goods is the numeraire and p_g is the tax price for government services g_i. The first order conditions from maximizing the median voter's utility subject to the budget constraint in equation (21) provide the median voter's demand for public services. However, there is a substantial amount of evidence suggesting the existence of spillovers with respect to state expenditures (see, Case *et al.*, 1993). Furthermore, evidence by Boarnet & Glazer (2002) and Kothenburger (2004) suggest that grants awarded to neighboring states provide important informational content used by neighboring states in determining the level of public services.[39] Following Case *et al.* (1993), spending spillovers as well as grants in neighboring states can be incorporated into the current model by allowing these to enter into the utility function of the median voter in state i.

$$\max U(x, g_i, g_j, z_j) \tag{22}$$

where g_j is the amount of public services in state j from which the median voter in state i receives utility (i.e. spillover effects) and z_j include grants awarded to neighboring states that capture informational externalities. The first order conditions from maximizing the median voter's utility in the above equation subject to the budget constraint in equation (21) provide the median voter's demand for public goods inclusive of spending and informational spillovers. The median voter's demand for public services is described by the following function in expenditure form (where $E_{it} = g_{it} * p_{it}$):

$$E_{it} = f(E_{jt}, z_{it}, I_{it}, z_{jt}, X_{it}) \tag{23}$$

where expenditures in state i at time t are a function of expenditures in neighboring state j (E_{jt}); grants in state i (z_{it}); income in state i (I_{it}); grants awarded to neighboring states (z_{jt}); and exogenous factors that determine state expenditures (X_{it}). Differentiating the first order condition with respect to the variables of interest, namely, E_{jt}, z_{it}, I_{it} and z_{jt}, provide the response function for state i. The expected sign on E_{jt} is positive indicating positive spillover benefits. The expected sign on z_{jt} is negative suggesting voter's perceive a relative increase in grants to state j, and not state i, as a signal for awarding prudent fiscal policies, thus serving to constrain own-state expenditures. Also, within this framework, the equivalence theorem of Bradford & Oates (1971) states that the stimulative effect of federal grants and income should be equal.

[39] Cited in Boarnet & Glazer (2002), others have argued that policies can signal competence, such as, Rogoff & Sibert (1988) and Rogoff (1990).

5.4 Data and Empirical Methodology

The data for this study contain the forty-eight contiguous US states over the period 1980 to 2008. Variables include intergovernmental grants from the federal government, personal income, and total expenditures. Control variables for the unemployment rate, debt outstanding, the poverty rate, dependency ratio, a dummy variable equal to one if the governor is a democrat and zero otherwise, and a dummy variable equal to one corresponding to a gubernatorial election year and zero otherwise. As discussed in the Chapter 2, cross-sectional averages were subtracted from each variable to mitigate other forms of cross-sectional dependence and focus on only spatial relationships.

To facilitate estimation I make use of a linearized versions of function (23) and define the following linear stochastic reaction function:

$$E_{it}^{*} = u_i + \gamma E_{-it} + \beta_1 z_{it} + \beta_2 I_{it} + \phi z_{-it} + \lambda X_{it} + \epsilon_{it} \tag{24}$$

where i and t index state and time, respectively. The variables E_{it}^{*} is the steady-state level of total expenditures; z_{it} is intergovernmental revenue from the federal government, I_{it} is personal income, and X_{it} is a vector of control variables. All variables are converted to real per capita terms. Individual intercepts used to capture time-invariant heterogeneity are given by u_i and the white noise error term is given by ϵ_{it}. The spatial interaction term for expenditures is denoted by $E_{-i} = \sum_j w_{ij} E_j$ which is defined as the average expenditures of neighboring states weighted by the predetermined weights, w_{ij}; where w_{ij} is an element in the 48x48 matrix W. The predetermined weights define "neighborliness" and for this study include two measures of geographic reference (i.e. contiguity and distance) and two measures of economic distance (i.e. population and income). For contiguity weights, $w_{ij} = 1$ if state i and j share a border and zero otherwise, and by convention, $w_{ii} = 0$. In other words, it is assumed that states that share a border interact and those that do not share a border do not interact. Inverse distance weights are defined as $\frac{1}{d^2}$, where d is the distance from each state's centroid. Income and population matrices are calculated as $w_{ijt} = m_{jt}$, where m_{jt} is neighbor j's level of population or real income per capita in year t, and the set of neighboring states is defined by the contiguity matrix described above. With respect to the time-varying weights, such as income and population, the diagonal is $(W_1, ..., W_T)$, where the weight matrix is a (NTxNT) block-diagonal matrix of spatial weights with T (i.e. number of time periods) copies of W along the diagonal.[40]

Equation (24) is state i's reaction function with respect to expenditures, which could broadly be interpreted as steady-state responses to actions of neighboring states (Baicker, 2005). When the weights are standardized the spatial lag term represents the average expenditures of rival states and therefore the coefficient γ measures the response of own-state spending to changes in rival state spending. A positive (negative) sign on the spatial lag indicates that expenditures are strategic complements

[40]The weights are standardized so that their row sums equal unity for each i.

(substitutes); and consistency with a Nash equilibrium requires that $|\gamma| < 1$, where the magnitude of the effect depends on the weights.

Boarnet & Glazer (2002) argue that federal grants to neighboring states can produce informational externalities informing citizens of the performance of their government which then translates to changes in own-state expenditure policies. Likewise, Kothenburger (2004) shows that states may compete for grants from the federal government by altering their fiscal policies. Consequently, state governments set their expenditures according to their neighbors' expenditures as well as the level of grants. These informational spillovers from grants have the ability to influence and provoke strategic competition across states. To allow for possible vertical externalities from federal grants, equation (24) includes a spatial lag on grants, $z_{-i} = \sum_j w_{ij} z_j$, therefore, the estimator ϕ captures informational spillovers from intergovernmental grants awarded to neighboring states.[41] The expected sign on ϕ is negative suggesting states decrease their expenditures relative to their neighbors to prevent the perception of waste by the median voter. In other words, consistent with yardstick competition, policy makers will respond to a rival state's grant award by decreasing their expenditures to ward off any perception of wasteful spending with the hopes of increasing their likelihood of re-election.

To relax the assumption that policy makers adjust their expenditures instantaneously the partial adjustment mechanism of Hayashi & Boadway (2001) is assumed as follows:

$$E_t - E_{t-1} = \lambda(E_t^* - E_{t-1}) \tag{25}$$

where $\lambda \in (0, 1)$ is a constant parameter, and a value of one indicates instantaneous adjustment and a value of zero indicates no adjustment. Hayashi & Boadway (2001) mention that partial adjustment can arise from such things as institutional rigidities or incrementalism. Plugging in equations (24) into (25) eliminates E^* and therefore the following equation describes the reaction function allowing for partial adjustment in expenditures.

$$E_{it} = \varphi E_{i,t-1} + \gamma E_{-it} + \beta_1 z_{it} + \beta_2 I_{it} + \phi z_{-it} + \lambda X_{it} + u_i + \epsilon_{it} \tag{26}$$

where $\varphi = (1 - \lambda)$ and $\varphi \in (0, 1)$. Consequently, a high value of φ indicates a slower adjustment process. Using equation (26), both short-run and long-run responses of expenditures can be examined. For example, in equation (26), the short-run response to a rival state's expenditure change is give by γ and the long-run response is given by $\frac{\gamma}{1-\varphi}$.

Prior to estimating the spatial lag equations, two econometric issues are addressed (see, e.g., Anselin, 1988). First, tests of spatial autocorrelation are employed to check for the existence of spatial autocorrelation with respect to expenditures and grants. Evidence of spatial autocorrelation across the two variables confirms the model set

[41] Weights are the same as those defined for expenditures.

up. Next, the use of spatial lag models induce a problem of endogeneity with respect to the spatial lag term, which causes biased and inconsistent estimates. These two issues are confronted in the next two sections.

5.4.1 Spatial Autocorrelation

The Moran's I and Geary's C tests are used to test for the existence of spatial autocorrelation with respect to expenditures and federal grants across each weighting matrix (i.e. contiguity, inverse distance, population and income). The Moran's I test statistic is calculated as follows:

$$I = \frac{\frac{1}{n^2}\sum_i \sum_j w_{ij}(Y_i - \bar{Y})(Y_j - \bar{Y})}{(\frac{1}{n^2}\sum_i \sum_j w_{ij})((\frac{1}{n}\sum_i (Y_i - \bar{Y})^2)} \tag{27}$$

where Y is the variable of interest and w_{ij} is the corresponding weight matrix. Negative (positive) values indicate negative (positive) spatial autocorrelation and a zero value indicates a random spatial pattern. The Geary's C statistic is calculated as follows:

$$C = \frac{\frac{1}{n^2}\sum_i \sum_j w_{ij}(Y_i - Y_j)^2}{2(\frac{1}{n^2}\sum_i \sum_j w_{ij})(\frac{1}{n-1}\sum_j (Y_i - \bar{Y})^2)} \tag{28}$$

here a value of one indicates no spatial autocorrelation, zero indicates positive spatial autocorrelation, and two indicates negative spatial autocorrelation. Both the Moran's I statistic and the Geary's C statistic are converted to Z-scores and the null hypothesis of no spatial correlation is tested against the alternative of spatial dependence.

Table 28: Tests for Spatial Autocorrelation

	Moran's I			Geary's C		
Variables	I	z	p-value	I	z	p-value
Expenditures						
Contiguity	0.243	12.898	[0.000]	0.752	-12.461	[0.000]
Distance	0.222	10.133	[0.000]	0.776	-9.749	[0.000]
Income	0.244	12.911	[0.000]	0.752	-12.425	[0.000]
Population	0.267	12.87	[0.000]	0.724	-11.295	[0.000]
Federal Grants						
Contiguity	0.209	11.134	[0.000]	0.776	-9.945	[0.000]
Distance	0.206	9.422	[0.000]	0.796	-7.933	[0.000]
Income	0.21	11.15	[0.000]	0.774	-9.975	[0.000]
Population	0.229	11.047	[0.000]	0.735	-8.066	[0.000]

Notes: All tests are conducted as 1 tailed test. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

The Moran's I statistic is inversely related to Geary's C, with the main difference being that the Moran's I tests for global spatial autocorrelation and the Geary C test is more sensitive to local spatial autocorrelation. The results for both tests are found in Table 28. All test statistics are statistically significant meaning expenditures, and federal grants display strong statistical evidence of spatial autocorrelation regardless of how neighborliness is defined. Consistent with the model setup, these results confirm the hypothesis that states spatially interact across expenditures and grants.

5.4.2 Endogeneity of Regressors

In equations (24) and (26) E_{-it} and E_{it} are simultaneously determined, causing E_{-it} to be correlated with the error term. In order to circumvent problems of endogeneity, the spatial lag equations are typically estimated using instrumental variables (IV) (see, e.g., Kelejian *et al.*, 2006), maximum likelihood estimation of the reduced form equation (MLE) (see, e.g., Easterly & Levine, 1998), or general methods of moments (GMM) (see, e.g., Conley, 1999).[42] More recently, Allers & Elhorst (2005) propose to first-difference the equation and then estimate using an unconditional likelihood, which they claim is superior to GMM estimation. However, the spatial lag equations here incorporate additional endogenous variables (e.g. z_{-it} and z_{it}), therefore, both MLE and IV are inconsistent. Furthermore, the number of cross-sections is greater than the number of time periods ($N > T$) prohibiting estimation of the disturbance covariance matrix which render MLE and IV infeasible, leaving GMM estimation as the only technique that overcomes these issues (Madariaga & Poncet, 2007 and Kukenova & Monteiro, 2008).[43]

5.4.3 System General Methods of Moments

In lieu of IV and MLE estimation, Arellano & Bond (1991) advocate GMM estimation using lags of the explanatory variables as instruments, which is conducive to studies where $N > T$ and when there exists multiple endogenous explanatory variables. Difference-GMM uses lags of the first differenced regressors from at least two periods earlier as instruments. The instruments, instead of the regressors, are differenced in order to make them exogenous to the fixed effects according to Arellano & Bover (1995) and Blundell & Bond (1998). Alternatively, system-GMM involves estimating each equation as a system of equations, one in levels and one in first differences. Lagged first differences of the regressors are used as instruments in the levels equation and lagged levels of the regressors are used as instruments in the first differenced equation. The use of instruments provides consistent estimators and the addition of

[42] Studies that use IV approach include Ladd (1992), Kelejian & Robinson (1993), Brett & Pinkse (1997) Brett & Pinkse (2000), Heyndels & Vuchelen (1998), Figlio *et al.* (1999), Fredriksson & Millimet (2002), Buettner (2001), Revelli (2001) and Revelli (2002). Studies that use MLE include Case (1993), Murdoch *et al.* (1993), Besley & Case (1995b), Bivand & Szymanski (1997), Bivand & Szymanski (2000), Brueckner (1998), Saavedra (2000), and Brueckner & Saavedra (1997).

[43] There is also the possibility of spatial autocorrelation in the error term; however, as discussed by Kelejian & Prucha (1998) IV estimation generates consistent estimates even in the presence of spatial error dependence.

the second equation allows for additional instruments to be obtained, thus increasing efficiency.[44] Kukenova & Monteiro (2008) apply the system-GMM procedure to equations with spatial dynamics in what they call ''extended system-GMM." They test (extended) system-GMM against spatial MLE, spatial dynamic MLE, spatial dynamic QMLE, difference-GMM and find that (extended) system-GMM outperforms all the rest in terms of unbiasedness based on the RMSE criterion.[45]

System-GMM offers a number advantages over traditional estimation techniques. As already mentioned, system-GMM corrects for endogeneity of the spatial lags as well as other possible endogenous explanatory variables. System-GMM also controls for other econometric problems such as measurement error and weak instruments. On a more practical note, system-GMM precludes the need to invert large spatial weight matrices which becomes more cumbersome as the number of cross-sections and time periods increase.

To obtain consistent system-GMM estimators the following moment conditions must be satisfied (Kukenova & Monteiro, 2008):

$$E(\Delta E_{i,t-1}\epsilon_{it}) = 0; for\ t = 3, ..., T \tag{29}$$

$$E(\Delta EX_{i,t-1}\epsilon_{it}) = 0; for\ t = 2, ..., T \tag{30}$$

$$E(\Delta z_{t-1}\epsilon_{it}) = 0; for\ t = 3, ..., T \tag{31}$$

$$E(\Delta W_{t-1}E_{t-1}\epsilon_{it}) = 0; for\ t = 3, ..., T \tag{32}$$

$$E(\Delta W_{t-1}z_{t-1}\epsilon_{it}) = 0; for\ t = 3, ..., T \tag{33}$$

$$E(E_{i,t-m}\Delta\epsilon_{it}) = 0; for\ t = 3, ..., T\ and\ 2 \leq m \leq t-1 \tag{34}$$

$$E(EX_{i,t-m}\Delta\epsilon_{it}) = 0; for\ t = 3, ..., T\ and\ 2 \leq m \leq t-1 \tag{35}$$

$$E(z_{i,t-m}\Delta\epsilon_{it}) = 0; for\ t = 3, ..., T\ and\ 2 \leq m \leq t-1 \tag{36}$$

$$E(W_{t-m}E_{t-m}\Delta\epsilon_{it}) = 0; for\ t = 3, ..., T\ and\ 2 \leq m \leq t-1 \tag{37}$$

[44]For more information on system and difference GMM consult Roodman (2006).

[45]Other studies that employ system-GMM include Madariaga & Poncet (2007), Foucault *et al.* (2008), and Hong *et al.* (2008).

$$E(W_{t-m}z_{t-m}\Delta\epsilon_{it}) = 0; for\, t = 3, ..., T\, and\, 2 \leq m \leq t-1 \tag{38}$$

where the first four conditions relate to the levels equation and the latter four relate to the first differenced equation. Notice for the extended version of system-GMM additional moment conditions (i.e. equations 32, 33, 37 and 38) are necessary to generate consistent estimates in the presence of endogenous spatial lags. While estimating the reaction equations, the two-step procedure is employed since it is asymptotically more efficient than the one-step; however, the two-step method suffers from severe downward bias (see, e.g., Arellano & Bond, 1991; Blundell & Bond, 1998).[46] To compensate for this bias Windmeijer (2005)'s finite-sample correction to the two-step covariance matrix is used.[47]

5.4.4 Validity Tests

Consistency of system-GMM estimators depends on the validity of the instruments, namely, the lagged levels and lagged first differences of the endogenous variables. Validity of the moment conditions depends on the absence of serial correlation in the level residuals and exogeneity of the explanatory variables. Moreover, efficiency relies on the "proper" choice of instruments. In order to ensure these validity conditions are satisfied three specification tests are employed: Hansen J test, Arellano-Bond test for serial correlation, and difference-in-Hansen test. Hansen's test of over-identifying restrictions analyzes the sample analogue of the moment conditions. The values are distributed χ^2 with the null hypothesis declaring a valid specification. Although robust, the Hansen test is weakened by many instruments. Further specification checks involve tests of first and second-order serial correlation in the first-differenced residuals using the Arellano and Bond test for serial correlation. Correctly specified instruments require significant negative first-order serial correlation in the residuals and no evidence of second-order correlation. Evidence of second-order serial correlation is indicative of serial correlation in the original residuals implying the instruments are misspecified and longer lagged instruments should be considered. Thus, significant first order serial correlation and the absence of second-order serial correlation suggests that the moment conditions are satisfied. Finally, in order to test whether system-GMM, as opposed to difference-GMM, is appropriate the difference-in-Hansen test is reported. The difference-in-Hansen tests the exogeneity assumption for the subset of instruments with respect to the differenced instruments used in the levels equation. Rejection of the null is evidence that difference, rather than system, GMM should be used.

[46] The two-step procedure includes estimating the covariance matrix under the assumption of i.i.d errors in the first step and then use the estimate of the covariance matrix in the second step which assumes the errors are correlated within individuals and not across them.

[47] Following the advice of Roodman (2006) the maximum number of instrumental lags are restricted to below the number of cross-sections (48), and the instrument set is collapsed. Collapsing the instrument set prevents generating one column for each time period and lag available.

5.5 Empirical Results

5.5.1 Steady-State Reaction Function

Table 29 reports the results from estimating the steady-state reaction equation (23) for each weight matrix (labeled at the top of each column). Column 1 provides the baseline estimates without considering strategic interactions from neighboring states. The coefficient on income (0.07) falls within the range commonly found in the literature; however, the coefficient on grants (1.83) is considerably higher than that found in the literature even after accounting for its endogeneity. The following four columns consider strategic interactions using various definitions of "neighborliness." Column 2 shows that the stimulative effect of grants on expenditures is positive and highly significant with a value of \$1.68. Private income stimulates expenditures by about \$0.03 for every dollar increase. These results confirm the longstanding flypaper effect. The coefficient on the spatial lag on grants is negative and statistically significant in all specifications, consistent with grants possessing informational externalities. Consequently, grants awarded to neighboring states reduce own-state spending by as much as \$1.29, thereby substantially limiting the flypaper effect. As a result, grants given to as single state have a much larger stimulative effect compared to grants distributed equally among all states. For example, \$1 awarded to an individual state would stimulate that state's expenditures by as much as \$1.70; however, if the federal government issues \$1 grant to every state the stimulative effect for each state would be only \$0.59. The positive and significant spatial lag term implies an upward sloping reaction function which suggests positive expenditure spillovers. Therefore, if state j raises their expenditures by \$1, state i responds by increasing their expenditures by \$0.59. These estimates are largely consistent with those found by Boarnet & Glazer (2002). With respect to control variables, the unemployment rate is positive and statistically significant in all specifications. Also, the dummy variable used to indicate election years is negative and significant in every specification indicating states reduce their spending during election years..

A review of the diagnostic tests indicate the model is correctly specified. The Hansen's J test is insignificantly different from zero, meaning the moment conditions are satisfied. Further confirmation of a correctly specified model is given by the Arellano-Bond test for serial correlation in which there is significant first order serial correlation and an absence of second order serial correlation. Finally, the difference-in-Hansen test shows up statistically insignificant indicating system-GMM is the preferred estimation technique.

5.5.2 Reaction Function Allowing for Partial Adjustment

Table 30 provides the results from estimating equation (26) allowing for partial adjustment in expenditures. Column 1 shows the baseline estimates without incorporating strategic interactions from neighboring states. The positive and significant coefficient on the lagged dependent variable confirms partial adjustment in expenditures. The speed of adjustment in expenditures is 0.35 (1-0.65), which translates to 35% of the

Table 29: Steady-State Reaction Function

Dependent Variable: Total Expenditures	(1) Baseline	(2) Contiguity	(3) Distance	(4) Income	(5) Population
Income	0.069***	0.034**	0.035***	0.032**	0.036***
	(0.011)	(0.014)	(0.011)	(0.014)	(0.012)
Grants	1.830***	1.676***	1.654***	1.705***	1.564***
	(0.269)	(0.164)	(0.185)	(0.156)	(0.141)
Spatial Lag Dependent	—-	0.737***	0.557***	0.733***	0.568***
		(0.115)	(0.098)	(0.117)	(0.112)
Neighbor's Grants	—-	-1.285***	-0.889***	-1.290***	-0.700**
		(0.317)	(0.237)	(0.317)	(0.280)
Unemployment Rate	58.343***	33.421**	31.335**	32.465**	37.022***
	(17.133)	(14.087)	(13.354)	(14.125)	(13.336)
Debt	0.168**	0.06	0.094**	0.056	0.047
	(0.074)	(0.045)	(0.045)	(0.045)	(0.048)
Population Density	-378.936	-331.805	-208.203	-283.139	-91.969
	(413.122)	(308.638)	(280.029)	(315.562)	(289.370)
Dependency Ratio	-1,077.793	-873.037	98.505	-820.033	-742.933
	(1,346.317)	(1404.940)	(1190.250)	(1388.000)	(1056.140)
Election Year	-23.272**	-19.804**	-22.524***	-20.173**	-22.145***
	(9.968)	(8.236)	(7.658)	(8.588)	(7.105)
Poverty Rate	-17.831	-2.073	-9.043	-1.612	-3.214
	(16.484)	(14.913)	(12.446)	(15.270)	(11.946)
Democrat	53.366	21.319	4.877	22.868	31.311
	(55.439)	(41.000)	(40.692)	(41.880)	(42.819)
Constant	215.486	-91.847	-346.913	-76.523	-81.372
	(691.799)	(775.270)	(718.062)	(771.518)	(647.491)
Observations	1,392	1,392	1,392	1,392	1,392
Number of States	48	48	48	48	48
AR(1)	-2.170**	-2.137**	-2.209**	-2.149**	-2.052**
AR(2)	0.061	-0.534	-0.657	-0.568	-0.349
Hansen's J Test	13.34	32.12	26.63	32.18	25.55
	[0.020]	[0.124]	[0.322]	[0.123]	[0.376]
Difference-in-Hansen Test	12.07	23.71	21.79	22.71	20.28
	[0.017]	[0.307]	[0.411]	[0.360]	[0.504]
Number of Instruments	15	36	36	36	36

Notes: Standard errors are in parentheses and probability values are in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

difference between the equilibrium and actual level of expenditures being eliminated in one year. Interestingly, the coefficient on grants is 0.67, which is very simliar to the estimate found by Case (1993); and the coefficient on income is now only 0.03.

The following four columns provide the estimates allowing for strategic interactions using different definitions of "neighborliness." The positive and significant coefficient on the lagged dependent variable confirms the existence of partial adjustment in expenditures. When accounting for strategic interactions, the partial adjustment is slower than in the base case. The coefficient on grants is positive and significant with a magnitude of approximately \$0.53 in the short run and \$1.90 in the long run. Meaning, for every dollar increase in federal grants, expenditures increase by \$0.53 immediately and over time translates to a total increase in expenditures by \$1.90. A dollar increase in private income increases expenditures by only \$0.01 in the short run and \$0.04 in the long run. The large difference between the short-run and

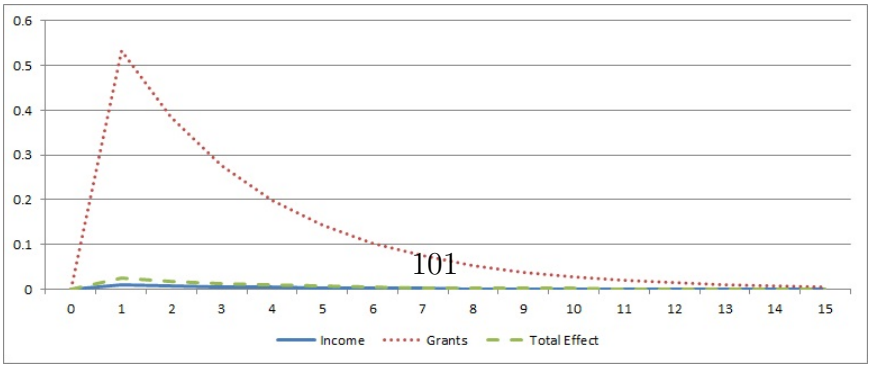
long-run propensity to spend grants and private income reveal an extended period of adjustment. Surprisingly, grants awarded to neighboring states completely offset the expenditure increase brought about by grants awarded to own state. Therefore, equal grants distributed among all states simultaneously will be counter productive in stimulating expenditures. However, grants awarded to a single state will stimulate expenditures by \$0.53, all else constant, which is consistent with the flypaper effect. Lastly, in agreement with the existence of budget spillovers, the coefficient on the spatial lag on expenditures is positive and significant. Interestingly, the control variables have limited significance in the short run. According to the diagnostic tests the models are correctly specified. There exists significant first order serial correlation and no evidence of second order serial correlation. Also, the Hansen and Difference-in-Hansen test statistics are insignificant suggesting that the instruments are exogenous and that system-GMM is the correct estimation procedure.

To illustrate the dynamics underlying the partial adjustment model a phase diagram is generated based of the estimates in column 2 of Table 30. Figure 27 plots the response of state expenditures to a one-time shock in income and grants. The line labeled "total effect" includes state i's response to state j's actions when their grants and expenditures increase by one dollar. First note the length of time before expenditures return to equilibrium following the stimulus. Following a one-time shock to grants it takes expenditures approximately ten years to return to equilibrium, and slightly faster response following an income shock. The dotted line represents the response from expenditures following the grant stimulus (holding constant income, and neighbor's activities) which produces an initial increase in expenditures in the amount of \$0.53, which is consistent with the estimates found in the flypaper literature. The solid line represents the response of expenditures to a one-time shock in income, all else constant. The difference between these two lines illustrate the flypaper phenomenon. In contrast, if state i also reacts to neighboring state j's expenditure decisions and grant awards then the flypaper phenomenon almost completely disappears as shown by the dashed line. This can be seen more clearly in Figure 28, which shows the difference between the stimulative effect of income and grants, after allowing neighboring states' grants and expenditures to change, amounts only to \$0.01
.

Table 30: Reaction Function with Partial Adjustment

Dependent Variable: Total Expenditures	(1) Baseline	(2) Contiguity	(3) Distance	(4) Income	(5) Population
Lagged Dependent	0.648***	0.720***	0.712***	0.721***	0.770***
	(0.076)	(0.058)	(0.058)	(0.059)	(0.080)
Grants	0.665***	0.534***	0.526***	0.530***	0.431***
	(0.131)	(0.097)	(0.122)	(0.099)	(0.146)
Spatial Lag Dependent	—-	0.339***	0.307***	0.335***	0.223***
		(0.060)	(0.061)	(0.061)	(0.065)
Neighbor's grants	—-	-0.848***	-0.649***	-0.828***	-0.529***
		(0.120)	(0.124)	(0.118)	(0.134)
Income	0.025**	0.011**	0.003	0.010*	0.010**
	(0.010)	(0.005)	(0.004)	(0.005)	(0.004)
Unemployment Rate	18.683	2.838	0.911	3.383	3.827
	(14.297)	(7.197)	(7.283)	(7.371)	(6.331)
Debt	0.048	0.017	0.038*	0.016	0.006
	(0.036)	(0.021)	(0.022)	(0.022)	(0.016)
Population Density	40.902	-161.264	-125.556	-154.425	-1.725
	(155.896)	(130.310)	(128.869)	(130.441)	(93.479)
Dependency Ratio	302.005	41.53	234.192	21.775	229.136
	(612.023)	(373.829)	(348.919)	(378.830)	(271.191)
Election Year	-13.261	1.548	-1.308	1.717	6.905
	(12.627)	(9.901)	(9.514)	(9.832)	(9.956)
Poverty Rate	-4.977	4.573	3.115	4.375	6.181*
	(9.041)	(4.206)	(4.205)	(4.334)	(3.535)
Democrat	27.035	8.468	4.133	7.081	15.36
	(31.339)	(19.267)	(20.965)	(19.664)	(16.015)
Constant	-278.928	-291.758	-244.805	-270.145	-379.856*
	(382.074)	(225.673)	(217.313)	(228.273)	(193.065)
Steady State Values					
Grants	1.89***	1.905***	1.827***	1.901***	1.874***
	(0.289)	(0.201)	(0.170)	(0.202)	(0.211)
Income	0.07***	0.038**	0.012	0.035**	0.044***
	(0.012)	(0.016)	(0.013)	(0.016)	(0.015)
Spatial Lag Dependent	—-	1.208	1.065	1.201	0.969
		(0.214)	(0.196)	(0.218)	(0.227)
Neighbor's Grants	—-	-3.023***	-2.252***	-2.971***	-2.299***
		(0.619)	(0.414)	(0.608)	(0.746)
Observations	1,344	1,392	1,392	1,392	1,392
Number of States	48	48	48	48	48
AR(1)	-4.762	-2.137**	-2.209**	-2.149**	-2.052**
AR(2)	-0.270	-0.534	-0.657	-0.568	-0.349
Hansen's J Test	35.27***	32.12	26.63	32.18	25.55
	[0.000]	[0.124]	[0.322]	[0.123]	[0.376]
Difference-in-Hansen Test	18.25**	29.15	30.02	30.33	28.24
	[0.019]	[0.258]	[0.224]	[0.212]	[0.297]
Number of Instruments	21	36	36	36	36

Notes: Standard errors are in parentheses and probability values are in brackets. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.



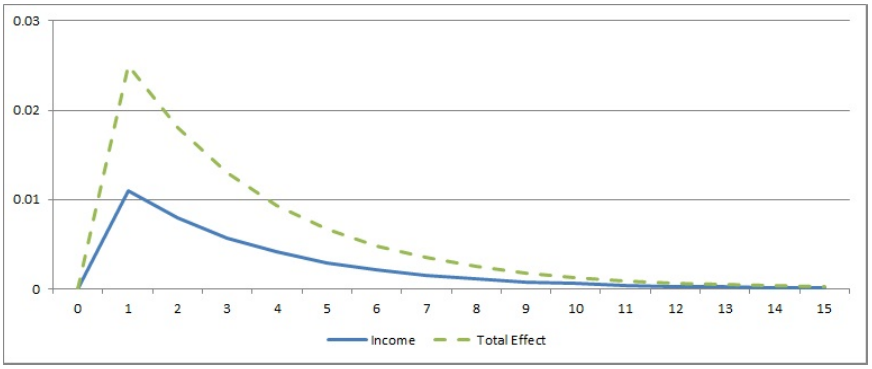


Figure 28: State Expenditure Response

In sum, the results confirm the longstanding flypaper effect; however, this effect is mitigated by grants awarded to neighboring states. For example, holding constant grants to other state governments, in the steady state, a $1 increase in grants increase state expenditures by $1.68, but if $1 of grants is distributed to all states then the total effect on state government spending amounts to only $0.59. Evidence here shows that allowing state's to react to their neighboring states is sufficient in explaining the flypaper phenomenon. These results highlight the importance of fiscal interactions in state spending decisions. Furthermore, the evidence favors an adjustment process in which it takes several years before expenditures return to equilibrium following shocks to either income or grants.

In developing grant policies, the results from this chapter show that fiscal policies in neighboring states must be considered given their influence on own-state fiscal policy. For example, a one time dispersement of grants to a single state will have a greater stimulative effect compared to a single dispersement to all states. Fiscal competition effectively constrains state governments spending, but potentially prevents grants from ameliorating interstate externalities. Moreover, the use of grants by the federal government to stimulate aggregate demand at the state level is effectively diluted by fiscal competition. For instance, without accounting for fiscal interactions a one dollar dispersement of grants to all states would stimulate total state expenditures by $80.64 (1.68X48); however, when allowing for fiscal interactions a one dollar dispersement of grants would stimulate total state expenditures by only $28.32 (0.59X48). A clear understanding of the ramifications of fiscal competition on state spending policies will help produce more efficient grant policies.

5.5.3 Expenditure Spillovers and the Flypaper Effect

This section calculates the indirect effect of spending spillovers on estimates of the flypaper effect. For instance, Baicker (2005) finds that the indirect effect from interstate spending spillovers is as large as the direct effect from own-state expenditures. If state i is receiving positive expenditure spillovers from neighboring states it seems plausible their reaction to a grant increase will be conditional on the level of spending spillovers. To test this, equation (26) is augmented with an interaction term capturing the indirect effect of expenditure spillovers on the stimulative effect of grants on

own-state expenditures. Equation (26) now becomes the following:

$$E_{it} = \varphi E_{i,t-1} + \gamma E_{-it} + \beta_1 z_{it} + \delta z_{it} * E_{-it} + \beta_2 I_{it} + \phi z_{-it} + \lambda X_{it} + u_{1i} + \epsilon_{1it} \quad (39)$$

According to (39) the flypaper effect can be decomposed into the direct and indirect effect of grants on expenditures as follows:

$$\frac{\partial E_{it}}{\partial z_{it}} = \beta_1 + \delta E_{-it} \quad (40)$$

where β_1 measures the direct effect and δE_{-it} measures the indirect effect resulting from spending spillovers. In other words the flypaper effect is conditional on the level of expenditure spillovers generated from neighboring states. Table 31 provides the results from estimating equation (39). The interaction term is evaluated at the minimum, mean, and maximum levels of the weighted average of neighboring state expenditures. The negative and statistically significant coefficient on the interaction term indicates that the flypaper effect is diluted by spending spillovers. For instance, estimates of the flypaper effect are greatest when expenditure spillovers are minimized. However, when evaluated at the maximum level of expenditure spillovers the flypaper effect becomes insignificantly different from zero.

Figures 29 and 30 illustrate the time path of expenditures following a one-time shock to grants including the indrect effect of spending spillovers evaluated at three different levels. The line labeled "flypaper effect (minimum)" is the response by expenditures following a one dollar shock in federal grants with a minimum level of expenditure spillovers. This reaches a peak around the high estimates found in the flypaper literature at about one dollar. When evaluated at the mean level of spending spillovers the grant stimulus reduces to \$0.64 which is incidentally approximately the average flypaper effect found in the literature. Finally, spending spillovers amounting to the maximum level reduce the grant stimulus down to only \$0.12, which is close to the high end of the average income effect found in the literature. The following graph, Figure 30, highlights the difference between the income effect and the stimulus from grants when spending spillovers are maximized. The difference between these two series is now only \$0.10.

Overall, the results suggest extensive fiscal interactions among states across both expenditures and grants. Consistent with yardstick comparisons, grants awarded to neighboring states effectively induce own state expenditure cuts. Consequently, the stimulative impact of grants on spending is mitigated by grants distributed to all states simultaneously, effectively limiting estimates of the flypaper effect. Furthermore, expenditures exhibit significant interstate spillovers. In fact, higher levels of interstate expenditure spillovers limit estimates of the flypaper effect to the point of providing little stimulus beyond a pure income effect. The results reveal the im-

Table 31: Reaction Function with Partial Adjustment and Asymmetries

	(1)	(2)	(3)	(4)
Weights	Contiguity	Distance	Income	Population
Panel A: Estimates				
Lagged Expenditures	0.698***	0.666***	0.691***	0.752***
	(0.0633)	(0.0690)	(0.0662)	(0.0684)
Grants	1.458***	1.546***	1.463***	1.248***
	(0.301)	(0.331)	(0.306)	(0.383)
Interaction term	-0.000204***	-0.000213***	-0.000205***	-0.000189**
	(6.66e-05)	(6.65e-05)	(6.81e-05)	(8.20e-05)
Spatial Lag on Expenditures	0.420***	0.382***	0.410***	0.336***
	(0.0878)	(0.0942)	(0.0893)	(0.105)
Spatial Lag on Grants	-0.758***	-0.500***	-0.706***	-0.543***
	(0.156)	(0.155)	(0.159)	(0.149)
Income	0.0180***	0.0142***	0.0176***	0.0159***
	(0.00502)	(0.00404)	(0.00500)	(0.00561)
Panel B: Estimates of the Flypaper Effect				
Total Effect Evaluated at the Minimum ($2161.79)				
$\frac{\partial E_{it}}{\partial z_{it}} = \beta_1 + \delta_E E_{-it}^{Min}$	1.017***	1.087***	1.020***	0.840***
	(0.172)	(0.202)	(0.174)	(0.216)
Total Effect Evaluated at the Mean ($4032.17)				
$\frac{\partial E_{it}}{\partial z_{it}} = \beta_1 + \delta_E E_{-it}^{Mean}$	0.636***	0.689***	0.636***	0.486***
	(0.102)	(0.121)	(0.103)	(0.104)
Total Effect Evaluated at the Maximum ($6580.88)				
$\frac{\partial E_{it}}{\partial z_{it}} = \beta_1 + \delta_E E_{-it}^{Max}$	0.116	0.147	0.114	0.005
	(0.185)	(0.171)	(0.189)	(0.193)

Notes: Standard errors are in parentheses and probability values are in brackets. The diagnostic tests all agree the model is correctly specified. Asterisks denote significance at the following levels: *** p<0.01, ** p<0.05, * p<0.1.

portance of interstate relations and dynamics in the development and distribution of transfers and in estimating the flypaper effect. Once allowing for partial adjustment and interstate interactions the flypaper effect is sufficiently accounted for.

5.6 Concluding Remarks and Further Research

Using data on a panel of US states over the period 1980 to 2008, the results in this paper highlight a number of important aspects with respect to state responses to federal grants. First, strategic interactions across states prove to be a robust determinant of state level spending both in terms of yardstick comparisons among grants and expenditure spillovers. Once accounting for state reaction to neighboring state policies, the flypaper effect ceases to exist. Moreover, another neglected element in estimating the flypaper effect includes accounting for the underlying dynamics. Approximately

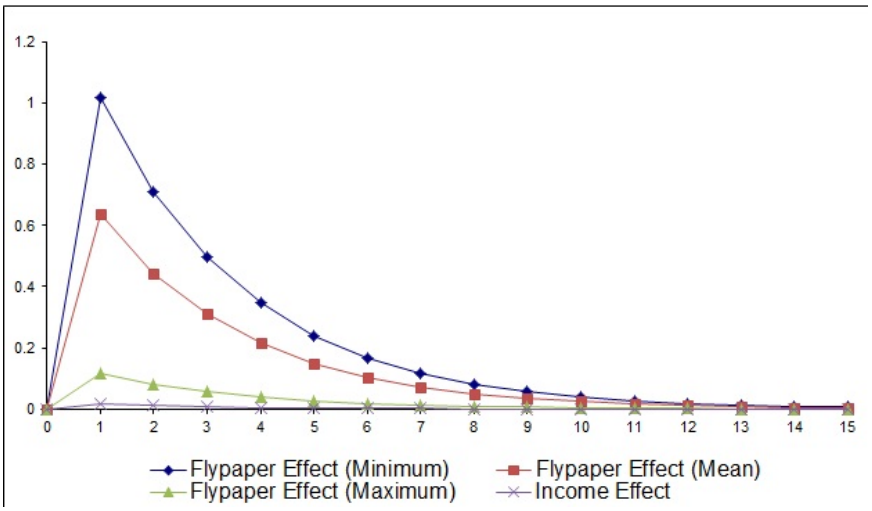


Figure 29: State Expenditure Response

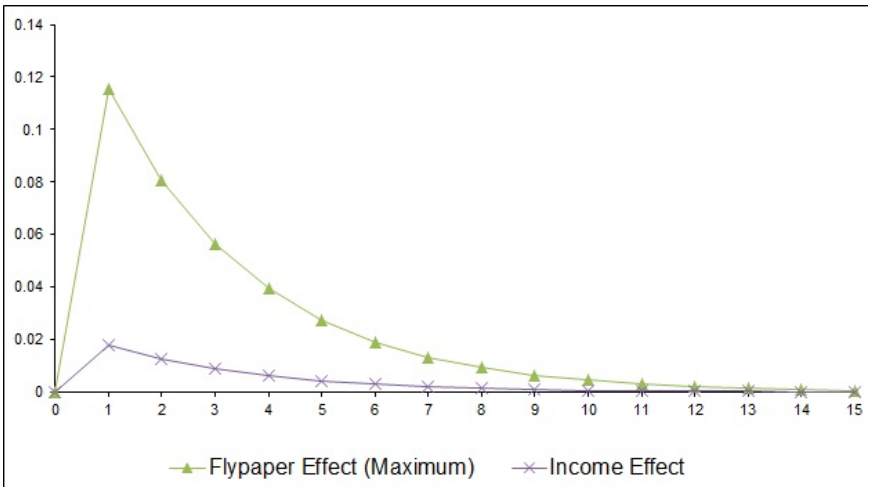


Figure 30: State Expenditure Response

thirty percent of the difference between actual expenditures and equilibrium expenditures is depleted within one year leaving seventy percent adjustment left to take place over the span of approximately ten years. Policy makers in the construction of grants and in the distribution thereof need to be vigilant as to how states are utilizing grants in order to develop more efficient transfer systems. Not only do grants stimulate expenditures, but they also serve as an effective signal to evaluate the competence of state government officials, which serve to constrain governments from overspending. Moreover, states are interconnected by spending spillovers which also limits the stimulating effects of grants. The results provided in this chapter suggest that the effect of grants used for the purposes of ameliorating interstate externalities or stimulating aggregate demand at the state level will be mitigated by fiscal competition. Furthermore, grants distributed to states produce their own information externalities. On the other hand, the evidence in this chapter favor a considerable amount of fiscal

competition across two dimensions is likely to impose efficiency enhancing constraints on Leviathan governments that engage in excessive spending (Hines, 2010).

6 Conclusion

Over the past several decades intergovernmental transfers have become a large revenue source for state governments. Understanding how states spend these transfers is of interest to policy makers and researchers alike. Given this fact, this dissertation focused on the role of intergovernmental transfers in the US. Using panel data on the 48 contiguous US states along with nonstationary panel and spatial econometric techniques, the three essays within this dissertation examined a unique question relating to the role served by intergovernmental transfers. For instance, the first essay examined the extent to which states serve as a conduit for federal funds to local governments; the second essay examined the influence of federal transfers on both revenues and expenditures; and the third essay looked at how federal transfers awarded to neighboring states influence on spending within a state.

The results from these essays contribute a number of interesting perspectives on how states spend federal transfers. The first essay shows significant evidence in favor of states serving as a conduit for funds from the federal to local governments in the long run, as opposed to using federal aid to finance state-level projects or distribute them as tax cuts. Furthermore, states use federal transfers to fund projects far removed from their intended allocation. For example, federal transfers for welfare and health and hospital are used to fund education transfers to local governments. Consequently, cuts to either welfare of health and hospital transfers to state governments could induce cuts to education funding to local governments.

The second essay shows how federal transfers play an active role in returning budgets to equilibrium. I also show that among states with relatively high amounts of debt, transfers are used to finance outstanding debt. Furthermore, federal transfers and own revenues display a complementarity relationship. Overall, these results suggest that federal grants display a very active role within state budgets.

Finally, the third essay shows that federal transfers awarded to neighboring states and spending spillovers dilute the effects of the grant stimulus. The omitted variable bias resulting from ignoring both neighboring state policies and dynamic relationships provide a sufficient explanation for finding a flypaper effect.

As the results of this dissertation suggest, federal transfers provide a number of important functions within a federation. The state is an interesting case given their intermediary position between the central government and local governments. Given the knowledge problem often found in any discussion of fiscal federalism and existence of spillovers from public goods among decentralized governments, the state provides a means of bridging the "cognitive distance" between the needs of the many decentralized local governments and the central government. States are conceivably in a better position to possess greater knowledge as to the efficient level of pubic goods and therefore better able to internalize local spillovers. Consistent with this idea states do in fact contribute to cross-program substitutions with respect to federal aid and aid to local governments discussed in Chapter 3, where states use federal aid for purposes of public welfare and health and hospitals to fund education expenditures at the local level.

Federal grants also produce possible perverse effects such as softening the budget

of subnational governments. The results from Chapter 4 find that states use grants to return their budget to equilibrium and, specific to states with relatively high amounts of debt, grants are used to finance debt obligations. In contrast, states with relative low debt levels rely more on own revenue sources to finance debt. Furthermore, high debt states support the tax-spend hypothesis (i.e. tax revenue increases encourage expenditure increases), where low debt states support the fiscal synchronization hypothesis (i.e. bidirectional relationship between tax revenues and expenditures), therefore high debt states are more likely to exploit tax revenues and use them to increase expenditures. These results combined with the fact that tax revenues and expenditures are fiscally separated in the short run support the devolution of taxing authority down to state governments thereby encouraging states to rely more on own revenue sources and less on grant revenues. In this case, tax competition should effectively limit over taxation and therefore over spending, with the added benefit of forcing states to be more fiscally responsible in matching the taxes with the benefits. These reforms, at least in principle, should help curb debt accumulation among states.

Related to the information problem inherent in fiscal federalism, Chapter 5 estimates the informational externality produced by federal grants given to neighboring states. Similar to federal grants awarded to universities and university departments provide information as to their competence which then encourages further grant awards, the same could be said with respect to federal grants awarded to state governments (see (Boarnet & Glazer, 2002)). The informational externalities given off by grants is one mechanism which enables voters to hold elected officials accountable thereby preventing wasteful spending and over taxation. For instance, citizens may view grants awarded to neighboring states, instead of their own-state, to reflect poor policy decisions of elected officials and therefore the citizens may choose to reduce their demand for expenditures. Furthermore, spending spillovers from neighboring states mitigate the stimulus associated with federal grants. These results suggest agree with Rodden *et al.* (2003) that in order to get Once thought of as an empirical anomaly, the results in this chapter suggest that the flypaper effect is a result of ignoring fiscal interactions that alter the spending patterns in response to federal grant stimulus.

Although this dissertation provides an empirical understanding of state-level fiscal relationships, it also opens the door to many other interesting and important research questions. Specifically, there are five main extensions from this dissertation that I am in the processes of pursuing.

First, we consider whether or not there is evidence of a "flypaper effect" as it relates to foreign aid distributed to developing countries.[48] A parallel can be drawn regarding the existence of a flypaper effect domestically within a country and internationally between countries. For instance, the central government issuing grants to local governments is analogous to developed countries supplying foreign aid to developing countries. The focus of this paper is to expand the current literature on the

[48]This study is a work in progress with fellow graduate student, Emily Marshall, and was an outcome from thoughtful discussions with Professor Wildasin.

flypaper effect to an international setting. Extending the discussion of the flypaper effect to an international environment will provide more variation in political and social factors to better inform a discussion of why the flypaper effect exists empirically. Exploiting the heterogeneity across countries, as opposed to using relatively homogeneous U.S. states for example, will enhance our understanding of why governments behave asymmetrically with respect to changes in lump-sum grants and income. Furthermore, this analysis will inform on the the appropriate design and distribution of foreign aid grants as well as domestic intergovernmental transfers. The preliminary results suggest evidence of flypaper behavior with respect to foreign aid. Moreover, political institutions, specifically the degree of executive recruitment and participation similar to the US, play key roles in generating a flypaper effect. We find that countries with regulated, competitive, and open election processes exhibit signs of flypaper behavior with respect to foreign aid.

The second extension relates to the effect of federal transfers on the size of state governments. According to Peacock & Wiseman (1979), idealized Keynesian policies advocate spending increases during recessions and spending reductions during times of economic boom, thus balancing the budget in the long run. However, realized Keynesian policies show an increase in government spending during recessions, but no offsetting spending cuts during economic booms. This results in a "ratchet" upward in the size of federal governments measured by government spending per real GDP. A similar case can be made with respect to federal transfers given to state governments. For example, an increase in federal transfers encourage funding to state level programs, but if decreases in federal transfers do not equally reduce funding to these programs, replaced instead with increases in own revenues or debt, then this can also generate a "ratchet" upward in the size of state governments. Especially since federal governments use federal grants to increase aggregate demand at the state and local levels during times of recession (Hines, 2010).

The third extension, relates to the effect of cross-sectional dependence (CSD) on estimates of the flypaper effect. For example, state i may be non-spuriously correlated with state j due to unobserved factors common to all states. Standard panel studies disregard the presence of common shocks and spillovers and instead assume cross-sectional independence or control for CSD using time dummies. If CSD is neglected it can lead to imprecise estimates and problems of identification. Therefore, neglecting CSD is one possible reason behind such a large flypaper effect (or a small income effect). Following the methodology set forth in Moscone & Tosetti (2010), I will use non-stationary and cointegration techniques to test the flypaper effect associated with the stimulative effect of federal grants on expenditures. Specifically, I will estimate the flypaper effect by relaxing the assumption of parameter homogeneity in the short and long-run and by accounting for a multi-factor error structure capturing both global and local spillovers using Pesaran's (2006) correlated common factor approach.

The fourth extension will examine the relationship between own revenues and federal transfers. Results found in this dissertation suggest a complementarity between own revenues and federal aid. Consequently, increases in federal aid result in increases in own-revenues rather than inducing a tax cut as expected. Given this relationship and the informational externalities associated with grants awarded to

neighboring states, I hypothesize that that grants awarded to states inform voters on the competence of their government, and therefore grants awarded to state i increase own revenues due to increasing the tax base as a results of migration into the state. Likewise, the increased perception of a competent government increases the ability of state governments to raise taxes and extract rents.

The last extension will focus on the link among the three layers of government in the US. The question of interest is how does the degree of decentralization effect estimates of the flypaper effect. Conceivably, a higher degree of decentralization permits greater control and accountability by the citizens over elected officials mitigating instances of wasteful spending. Similarly, citizens in decentralized governments are less likely to succumb to fiscal illusion for the same reasons. If this is the case then we should find a larger flypaper effect associated with federal grants to state governments than with state grants to local governments. These results can be checked for robustness using cross-country data and an index of decentralization.

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Refereed Journal Publications

"The Effect of Inter-Country Competition on Interest Rate Pass-Through in the European Union." with R. Bista and B. Maskay, *International Journal of Monetary Economics and Finance*, forthcoming.

"Tax-Spend Nexus in Greece: Are There Asymmetries?" with N. Apergis and J. E. Payne, *Journal of Economic Studies*, 39(3), 2012, 327-336.

"An Empirical Note on R&D Growth Models with Regional Implications." with J. E. Payne, *Journal of Regional Analysis and Policy*, 41(1), 2011, 16-21.

"Are Adjustments in the U.S. Current Account Asymmetric? Another Look at Sustainability." with J. E. Payne, *International Journal of Economics & Business*, 1(1), April 2011, 1-10. [LEAD ARTICLE]

"Tax More or Spend Less? Asymmetries in the UK Revenue-Expenditure Nexus." with J. E. Payne, *Journal of Policy Modeling*, 32(4), July-August 2010, 478-487.

"New Evidence on Modeling the Phillips Curve and Time-Varying Volatility." with J. E. Payne, *International Economics*, 60(3), 2007, 355-364.

Work in Progress

"Panel Evidence on the Change in Real Interest Rate Persistence." with N. Apergis, C. Christou and J.E. Payne. *Under Review*

"Spatial Dynamics of U.S. Cigarette Demand." with Rajeev Goel and Sherrlyn Billger. *Under Review*

"The Dynamics of Sectoral Electricity Demand for a Panel of US States: New Evidence on the Consumption-Growth Nexus." with Brandon Sheridan. *Under Review*

"The Dynamics of the Revenue-Expenditure Nexus in State Government Finances." *Under Review*

"Exploring the Dynamics of Intergovernmental Linkages: Is the State a Conduit for Funds?" (Job Market Paper)

"An Empirical Investigation of Fiscal Interactions and the Flypaper Effect."

"The Flypaper Effect: New Evidence from a Panel of Countries" with Emily Marshall.

"The Effect of Cross-Sectional Dependence on Energy Demand Among U.S. States." with Hassan Mohammadi.

"Estimating the Inequality and Growth Nexus Using Non-linear Panel Cointegration." with N. Apergis, C. Christou and J.E. Payne.

"Federal Grant Induced Ratchet Effect on U.S. State Level Spending."

Awards

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